SWC Space Tactics Bulletin

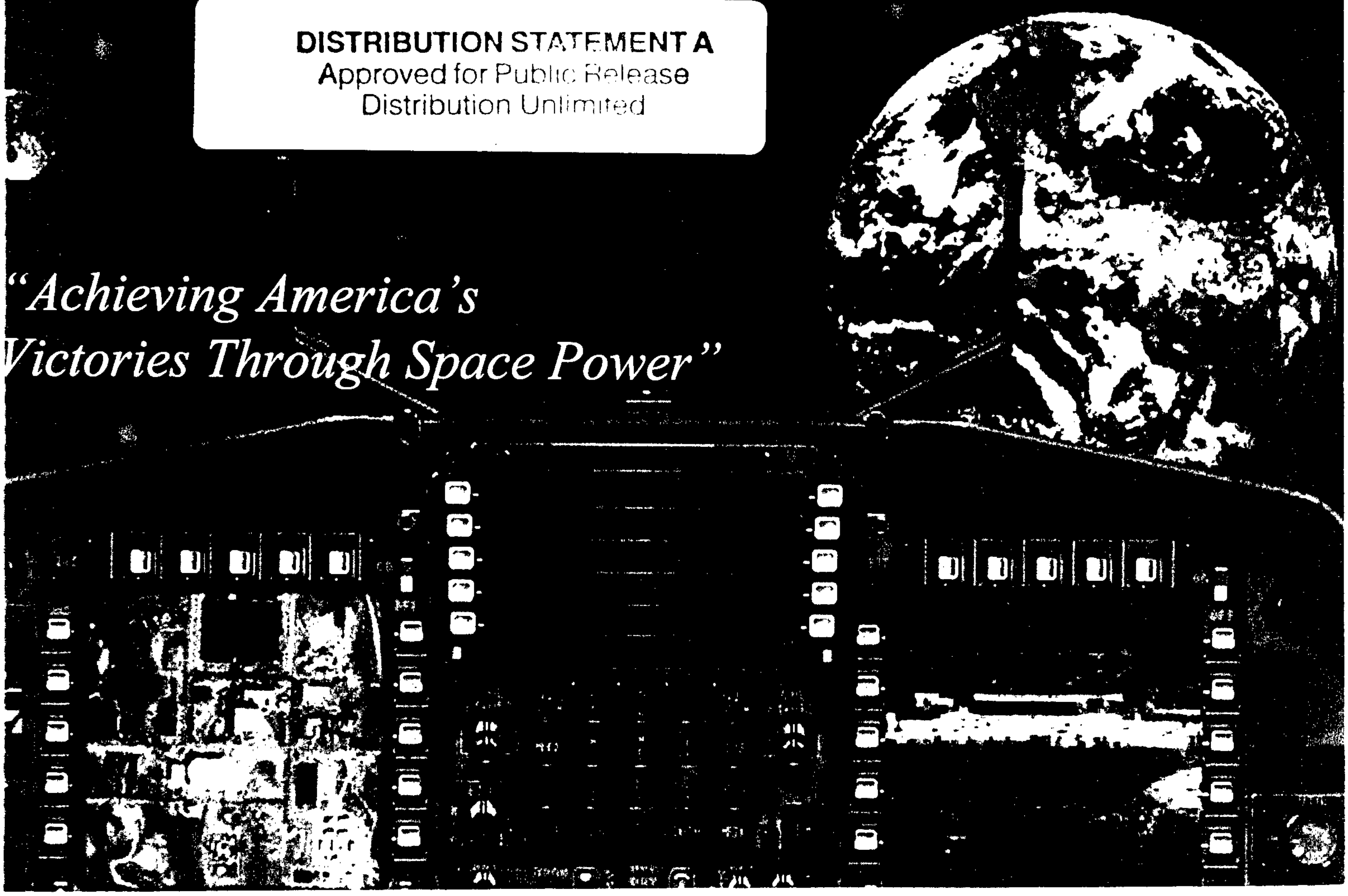
Spring/Summer 1999

Volume 6, Issue 4

19990913 098

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

"Achieving America's Victories Through Space Power"



SWC Space Tactics Bulletin

Spring/Summer 1999

Volume 6, Issue 4

IN THIS ISSUE

The Space Tactics Bulletin
Volume 6, Issue 4, Spring/Summer 1999

The Under Secretary of the Air Force has determined that the publication of this periodical is necessary in the transaction of the public business as required by law of the Department. Use of funds for printing this publication has been approved by the Commander, Space Warfare Center, in accordance with AFI 37-160, Volume 4.

The Space Tactics Bulletin is published four times a year by the Space Warfare Center (HQ SWC/DOTW), 730 Irwin Avenue, Suite 83, Schriever AFB CO 80912-7383, (719) 567-9586, or DSN 560-9586. E-mail: wolfebj@swc.schriever.af.mil.

Mr. F. Whitten Peters
Acting Secretary of the Air Force

Gen Richard B. Myers
Commander, Air Force Space Command

Colonel Gary R. Dylewski
Commander, Space Warfare Center

Ms. Bobbie Wolfe
Editor

The Space Tactics Bulletin is an official, nondirective SWC publication. Its purpose is to update warfighting staffs and units on SWC efforts to effectively employ space assets in support of operations, and provide a forum for information exchange to improve space tactics and procedures. The views and opinions expressed herein, unless otherwise specifically indicated, are those of the individual author. They do not purport to express the views of the SWC Commander, the Department of the Air Force or any other department or agency of the United States Government.

Contributions, suggestions and criticisms are welcome. Final selection of material for publication is made on the basis of suitability, timeliness and space availability. Address communications to *The Space Tactics Bulletin*, HQ SWC/DOTW (Editor), 730 Irwin Avenue, Suite 83, Schriever AFB CO 80912-7383, DSN 560-9586. E-mail: wolfebj@swc.schriever.af.mil. Fax: Comm (719) 567-9591, DSN 560-9591.

DTIC QUALITY INSPECTED 4

COMMANDER'S CORNER

Welcome to the Spring/Summer 1999 issue of the Space Tactics Bulletin. As the new Commander of the Space Warfare Center, I'm committed to offering you innovative ideas on the employment of space assets. Publishing the Space Tactics Bulletin (STB) does just that. Many of our Air Force, joint, and coalition forces are still learning about space and what role it plays in their missions. Space is an enabling force behind our doctrine. The warfighter must be keenly aware of the linkage between doctrine and the space assets we use. Our task of educating the forces on the enabling role of space is made more complex as national policy, warfighting doctrine, technology, and space employment concepts continue to rapidly evolve. If in doubt, ask yourself a simple question as a sort of litmus test. How well could NATO have achieved its objectives in Kosovo without unrestricted access to space assets?

Articles of particular interest in the Spring/Summer issue are: "The Large Value of Small ICBM's" by Capt Chuck Williams; "Fundamentals of a Space Tactics Flight: Lead, Teach, and Be Flexible" By Capt Mike Lutton; and "Satellite Tracking Using Ambient RF (STAR)" by Major Wayne Rezzonico. Capt Williams identifies a possible solution to the aging ICBM fleet--the Small ICBM that was fully tested during the late 1980s. This capability could prove to be a cost-saving alternative to maintaining the current ICBM fleet. Capt Lutton's article points out the value of a unit's tactics flight. Many units don't have a robust system for capturing and analyzing lessons learned from exercises and other training activities. Failure to learn from the lessons of the past will cause units to repeat the same mistakes in the future. This is especially true when personnel rotate out of units and corporate memory is lost. Tactics officers must lead the way out of this cycle. Major Rezzonico's article reveals a Space Battlelab initiative to augment the Space Surveillance Network (SSN) for near-earth orbits by utilizing ambient RF energy from UHF transmitters. There are several articles written about SSN augmentation initiatives, but I find this one clearly defines the current problem, and presents a credible solution. The 50% increase of space objects (satellites, rocket bodies, and junk) since 1980, and four sensor site closures in the last eight years, has stressed the ability of the SSN to track and maintain current information to its limits. The initiatives explained by Major Rezzonico could improve our ability to track Space Order of Battle dramatically.

I also want to draw your attention to our classified Winter 1998/99 issue. This issue is published on the Space Warfare Center's SIPRNET homepage. A classified issue permits the authors to include details about space activities that ordinarily are prohibited for unclassified issues. Hence, the articles make for more interesting reading and offer a more complete picture of the space issue/activity. Our webpage address is: **URL: http:www.swc.spacecom.smil.mil**

The articles we receive for publication are informative, and span all areas of the space community. In order to remain true to the purpose of the STB, and for this publication to retain its effectiveness, the SWC will continue to raise the bar. All articles that are submitted must follow strict guidelines. Articles must be concise and accurate. Opinions are good to stimulate thought, but they must remain separate and distinct from documented, objective data provided in your submissions.

Thank you for supporting this bulletin and submitting articles. I encourage you all to be ambassadors of space. As stated above, many segments of our sister services, as well as Air Force personnel are still learning about space. Most know general capabilities, but few actually comprehend how to effectively employ space systems, and how dependent military forces are on our space systems. Declining budgets often strain programs and new initiatives, but understand that as we become leaner, our space capabilities provide the opportunity to combine efforts and increase the effectiveness and lethality of our armed forces.

GARY R. DYLEWSKI
Colonel, USAF
Commander, Space Warfare Center

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

HEADQUARTERS, AIR FORCE SPACE COMMAND WEAPONS AND TACTICS BRANCH

Capt Richard W. Boltz, HQ AFSPC/DOTW, DSN 692-4335

Introduction

Historically, Headquarters, Air Force Space Command (HQ AFSPC) hasn't looked at weapons and tactics in the same way as the flying community. As a result, it wasn't equipped with what it needed to successfully manage a Weapons and Tactics program. All that has changed. In November 1998, the Operations Training and Evaluation Division (HQ AFSPC/DOT) welcomed its newest branch, Weapons and Tactics. The Weapons and Tactics Branch (DOTW) serves as the AFSPC executive agent for weapons and tactics programs to include:

- Tactics Development and Documentation
- USAF Weapons School Space Division Liaison Activities
- "W13xx" Career Management
- "New Guy" Program
- Weapons and Tactics Annual Awards Program
- Electronic Warfare / Space Aggressor Team Advocates

Tactics Development and Documentation

One of our primary responsibilities is creating the necessary instructions that guide proper tactics development and documentation. DOTW has made good progress developing the AFSPC instructions. Currently we have two instructions in draft: AFSPCI 11-415, Weapons and Tactics Program and AFSPCI 99-150, Combat Air Forces (CAF) Test and Evaluation. These instructions will be sent out for official coordination when their corresponding AFIs are approved and released.

For a long time, AFSPC units have had documented tactics, techniques and procedures (TT&Ps). They just weren't in the format that the rest of the Combat Air Forces (CAF) could use. As part of the CAF, we are now committed to developing standard processes for documenting and approving TT&Ps. Air Force Tactics, Techniques and Procedures (AFTTP) for space will be captured in AFTTP 3-1, Volume 28, Tactical Employment. Along those same lines, we proposed a transition of the fundamental space information found in the both 3-1, Vol. 28 and the Aircrew Combat Information Guide into a new AFTTP 3-3, Volume 28 – Space Fundamentals.

In addition to defining the requirements and content out of Volume 28 for both AFTTP 3-1 and AFTTP 3-3, DOTW is responsible for ensuring that space capabilities are properly folded into the other weapons system volumes. We are involved in multiple reviews of these volumes throughout the approval and coordination process. Since November 1998, our office has coordinated for A/OA10, HH-60, U-2, Joint STARS and Threat Reference Guide volumes.

Equally important to the documentation of TTPs is the capability to capture improvements. The Tactics Improvement Proposal (TIP) process allows space operators to do just that. Using Multi Command (MC) Form 1007, operators can recommend a new TTP to address deficiencies. Operators forward these TIPs through their appropriate weapons and tactics shop.

Each November, DOTW will host the annual AFSPC Weapons and Tactics Conference. This conference will encourage the crossflow of ideas between our tactics officers. The discussion guidelines and recommendations that result will set the stage for those TIPs we plan on taking to the AFSPC Tactics Review Board (TRB). The TRB in turn will review the TIPs submitted by subordinate units. Those TIPs with CAF-wide applicability will be forwarded to the CAF TRB. Others will only be applicable to AFSPC units and will remain within command channels. TIPs that make it through the review and approval processes end up being incorporated into AFTTP 3-1.

USAF Weapons School Space Division Liaison Activities

DOTW works very closely with the United States Air Force Weapons School, Space Division, on a variety of issues. One of these is "W13" billet validation and prioritization. The past 12 months has seen an increased demand for space weapons officers. Unfortunately, the demand exceeds the supply. As a consequence, DOTW continually assesses the requirements for "W13" billets and establishes a priority of slots to fill.

DOTW is also the focal point for Weapons School process. We ensure that all packages that meet the board are in the proper format. Second, DOTW provides a voting member for the Weapons School Selection Board. Third, DOTW provides the requirements for the Space Warfare Center's "Spin-Up" course for all space officers selected to attend Weapons School. This course brings everyone up to a common level prior to going to Weapons School. Finally, DOTW provides feedback to the Space Division to make sure that the curriculum meets the needs of the units receiving Space Division graduates

"W13xx" Career Management

Following graduation, our weapons officers have some unique capabilities that should not go to waste. We have developed a database that allows us to track where our graduates have been and what jobs they have done. This, coupled with knowing what "W" jobs are opening and when, enables us to make the best match for the job. Our goal is to have DOTW actively involved in the assignment of any "W13."

"New Guy" Program

One of the ideas that we are pushing is the establishment of a "New Guy" Program. The goal of this program is to produce space operators with a solid understanding of how they fit into the larger roles and missions of the Air Force. Ideally, each wing weapons and tactics shop would implement a year long program that provides the wing operators with an introduction to weapons and tactics, space systems Air Operations Centers, space doctrine and Combat Air Force (CAF) capabilities.

Weapons and Tactics Annual Awards Program

DOTW wants to ensure that the people doing a great job in bringing weapons and tactics to the command are appropriately recognized. We plan on awarding three annual awards: The AFSPC Weapons and Tactics Shop of the Year, The AFSPC Weapons and Tactics Officer of the Year, and The Weapons and Tactics NCO of the Year. These awards will be announced at the annual AFSPC Weapons and Tactics Conference.

Electronic Warfare / Space Aggressor Team Advocates

Electronic Warfare and Space Aggressor Team activities are going to be in greater demand in the near future. We feel that DOTW needs to be a HQ AFSPC advocate for these teams. This advocacy will push for proper employment to help our units identify vulnerabilities and develop appropriate counter-tactics.

Conclusion

DOTW stood up in late 1998 and has already made significant strides in running the weapons and tactics program like the rest of the CAF. A lot of work lies ahead, however, because the reward for work well done is more work. If you have any questions, please feel free to contact Lt Col JJ Gagnon, Chief, Weapons and Tactics at DSN 692-3726, Comm (719) 554-3726 or gagnonj0@spacecom.af.mil (email).

CONVOYS INTO THE NEXT CENTURY

Capt Benny Landfair, 91 SFS/SFT, DSN 453-2044

Grease boards, grid status checks, unsecure land mobile radio, 5-minute location updates and vehicle spacing are all too familiar to a Security Forces convoy commander even in 1999. Space wing re-entry vehicle (RV) convoys are tracked at all times in order to comply with nuclear safety, surety and security rules. To do this, each convoy commander must locate the convoy's position on a hard-copy map and report it to the Missile Security Control (MSC) Center at intervals no greater than five minutes. This information is recorded at the MSC and plotted manually on maps. This method is appropriate for the industrial age, but not the information age. In moving to keep pace with evolving threats, and safeguard nuclear assets, we must incorporate current space-based technology. Enhancing our current capabilities to monitor synchronize, direct, integrate and execute assigned forces becomes even more important as those forces become smaller, and the threat becomes more ubiquitous. The problem of outdated space wing technology was posed to the AF Space Battlelab.

Proposed Solution

Satellite Tracking of Re-entry Vehicle Convoys (STORC). The proposed concept involves automatic convoy tracking via satellites. A Global Positioning System (GPS) receiver combined with a satellite linked communications transmitter can perform convoy tracking. STORC allows the RV convoy to be tracked more precisely and in real-time. The MSC is equipped to receive the GPS information and display the RV convoy location on a digital map. The system transmits information back to the MSC via a secure defense encryption standard (DES) communications. The communications path back to the MSC is via satellite to a ground station and then from that station to MSC. STORC also enhances the commander's situational awareness. The system is able to transmit near real-time digital photos from the convoy to the MSC. The AF Space Battlelab funded a demonstration of STORC to prove the system's feasibility. The demonstration is scheduled for Minot AFB ND in September 1999.

Once the STORC concept is proven, it could be employed at Minot, F.E. Warren, and Malmstrom Air Force Bases. Given the often extreme conditions at northern tier bases, STORC has the potential to do more than just track convoys. It can be expanded to track all vehicles in the space wing. This would aid in the rescue of stranded personnel and enhance command and control of Security Forces responding to a security situations. Missile maintenance may also benefit from STORC by tracking maintenance teams and equipment in the field and using real-time digital imagery to troubleshoot maintenance problems.

STORC is just one small step to move the Air Force into the next millennium by enhancing RV convoy security with today's technology. The Space Battlelab can answer questions on STORC; the POC is Capt Kendra Eagan @ DSN 560-9117.

ADVERSARIAL SPACE FORCE

Capt Thomas Meyer, HQ SWC/DOG, DSN 560-9593

United States military reliance on space is increasing. We have created a vulnerable "center of gravity" which can easily be exploited by space-capable adversaries. From communications, global navigation, intelligence, weather, and surveillance, thousands of electronic bits stream down from above to keep our forces prepared and capable. Without this information gateway, our globally deployed forces would be without those eyes and ears we increasingly depend on to react in an effective manner. There is a need for a professional space adversary force within Air Force Space Command to counter this threat.

Operation DESERT FOX exploited space capabilities. Military satellite communications disseminated information within the theater to individual units and provided the long-haul communications to commanders. The Global Positioning System (GPS) guided the initial waves of cruise missiles and provided pinpoint navigation to the follow-on fighters as they engaged their targets. The Defense Support Program (DSP) diligently watched for Iraqi SCUD launches to provide early warning of potential use of weapons of mass destruction. Meteorological satellites played a key role in identifying where allied forces could strike military targets effectively. Intelligence satellites flying overhead provided necessary bomb damage assessments and tracked Iraqi forces. Operation DESERT FOX could have been conducted without space assets, but the outcome would not have been as successful.

U.S. adversaries are aware of our dependence on space assets to wage war. The former Soviet Union once employed assets designed specifically to disrupt allied satellite communications. The fiscal reality of the new Russia means that this equipment is now for sale. Large military infrastructure and high defense spending are not required to obtain a space capable force. The explosion of information over the Internet makes it possible to enhance one's own space capability while denying an adversary their use of space. For instance, 3-meter resolution commercial imagery can provide intelligence data without the expense of launching a multibillion-dollar space system. Future commercial systems will provide enhanced 1-meter imagery available in hours. To deny adversaries their space capability, one needs only to research on-line. Information on how to piece together a jammer, information on currently used military satellite frequencies, and on-line equipment catalogs are all that is needed to build a space denial capability. Only $10,000 worth of equipment can deny a $100M satellite from achieving its mission.

The Space Warfare Center (SWC) located at Schriever AFB outside Colorado Springs, CO, is educating military forces on the threat. The Space Aggressor Team (SAT) employs many of the methods a space capable adversary might use against the U.S military. What the Nellis Aggressors did for air combat in the mid-1970's, the SAT will do for space in the late 1990s and beyond. New pilots flew their first combat missions against the Aggressors during RED FLAG. This gave them realistic experience modeled after the current threat; this prepared them for actual combat. Space operators do not have similar training opportunity.

To date, few space operators know what electronic warfare (EW) looks like. Communication failures, degradation in satellite command & control, or failure to maintain GPS lock are typically attributed to equipment failure. Operators are more likely to troubleshoot equipment and perform maintenance than suspect intentional, external intrusion. Processes exist to detect hostile EW emitters. However, users must be aware of intentional jamming before these processes are employed. Also, equipment used to detect EW would have difficulty identifying the multiple, mobile, low-power jammers capable of disrupting satellite links.

The SAT will use open source information on the Internet to ascertain troop and equipment movements which may point to an upcoming operation. Commercial satellite imagery will provide intelligence on forward-deployed locations and compromise the force protection planning. Under exercise conditions, the SAT will employ Commercial Off-The-Shelf (COTS) based technology to deny critical communications links. As the Air Force moves toward the Aerospace Expeditionary Force (AEF), the forward basing combined with the reachback to units in the United States is crucial to the early halt phase of the AEF concept. Deny security at the forward operating location or sever communications with CONUS based assets, and the operation is hindered. With GPS jamming in the theater, guided munitions are less accurate, weapon system synchronization is disrupted, and

ground units may be lost.

Protecting this new center of gravity is critical to U.S. joint forces. The military needs to stand up the Space Aggressor Team so the first time we face a space capable adversary is during training, not actual conflict.

FUNDAMENTALS OF A SPACE TACTICS FLIGHT: LEAD, TEACH AND BE FLEXIBLE

Capt Michael Lutton, 32 AOG/SAEF

"Many aviators who were killed might have been saved had they been equipped with parachutes. . . but they were turned down as useless until after the Armistice—not by the War Department, but by the flying officers themselves." (Hudson, 299)

"As a combat force the American Air Service had come a long way from its cautious beginning in April, 1918, when a single observation squadron equipped with obsolescent aircraft and two pursuit outfits flying unarmed Nieuports ventured into the skies over Toul" (Hudson, 300). As most airmen realize, the similarities between the early Air Service and space operations are quite remarkable: both were born of technological innovation, both shared early growing pains in the drive to become "operational," and both proved their critics wrong in combat. As with any new military venture, the early Air Service, much like space operations today, suffered from a lack of established tactics to employ in the full spectrum of conflict. For example, early Air Service tacticians discovered:

> *… in day-light bombing that the Breguets and DH-4's simply did not have the range necessary for deep penetration. Nor did they have the bomb carrying capacity adequate for true strategic bombing. The Trenchard-Mitchell thesis of diverting enemy pursuit aircraft from the battle front to protect rear area targets did prove a success but at a bloody cost to the day bombardment crews* (Hudson, 301).

As the fledgling Air Service transitioned to an Air Corps, tactics became a fundamental cornerstone of successful air operations.

As air and space operations continue to become inextricably linked in combat operations, the need for space tactics becomes ever more important. How will space tactics become a reality? Operators, led by the wing tactics flight, will make it happen. The tactics flight is vital to the success of the wing's mission as well as the Joint Forces Air Component Commander's (JFACC) mission. This paper discusses three fundamental ingredients required of any wing tactics flight.

Three fundamental ingredients establish a first-rate tactics flight at the wing – a flight must **lead**, **teach** and **be flexible**. How can we apply these abstract words to a flight that needs to produce results? To make these more than just words, this paper examines some "rules" of leadership. With an understanding of the flight's leadership role, we must also understand our "teaching" role. A very effective "teaching" tool is the performance or mission debrief. A thorough debrief is key to successful teaching. Debriefing doesn't have a formula. This paper will offer a few tech-

niques to help ensure a successful debrief. Finally, a tactics flight must be flexible to new ideas. A tactics improvement process ensures flexibility and eliminates "stovepiping." To tie the ingredients together, a few thoughts on how to "maximize our three-month stay in the 'quiet' Toul sector" before we move to the sound of gunfire once again.

Lead

"Leadership is the Art of accomplishing more than the science of management says is possible." (Powell, 264)

The art of leadership is key to starting the tactics flight. Strong leadership will allow the flight to overcome formidable leadership challenges early on: tactics development, educating the wing on the tactics process, and providing a product that fulfills mission requirements. Leadership skills enhance the flight's ability to achieve the desired mission end-state for themselves, the crew force, and the senior leadership. As most agree, leadership skills are developed, refined, and polished in our professional "environment." I've provided several "Rules" to guide the flight in any environment:

1. *Have a vision (long range strategy). Be demanding.*
2. *Keep an "It can be done" attitude! But maintain the integrity to question an idea, no matter the source.*
3. *Check small things.*
4. *Share Credit.*
5. *Remain calm. Be kind.*
6. *Avoid having your ego so close to your position that when your position falls, your ego goes with it.*
7. *Don't take counsel of your fears or naysayers.*
8. *Perpetual optimism is a force multiplier.*

(Powell, 613)

All "Rules" are not created equal. If a flight needs to have a guiding leadership rule, it must be "Rule" #1. As a tactics flight, give your team, and the wing, a vision. The vision begins with the flight identifying its role and responsibilities within the wing organization. Sources to help the flight identify roles and responsibilities might be higher headquarters instructions, the numbered air force weapons and tactics flight, the MAJCOM weapons and tactics office, and even other wing tactics flights. Establishing a vision within the flight might seem difficult. The truly difficult task is getting the folks within the wing to be a part of the vision. To form a long range strategy, the flight needs to answer a couple short but challenging questions: "Where do we want to be in 1, 5, and 10 years?" and "What are our objectives for getting us there?"

By adopting all of these rules and establishing a vision, the tactics flight enhances its leadership skills and builds a flight, not an empire, that fosters teamwork and success at the wing.

Teach

"He who cannot cope with reality himself is certainly lacking the heart to lead others through crisis." (Vice Admiral James Stockdale, 41)

As a tactics officer, a good part of your day will be spent with crew members throughout the wing. Discussion will center on concepts, tactics, techniques, and procedures. In order to find new concepts, tactics, techniques, and procedures, crew members and tactics officers will be required to discuss what they did right and what they did wrong. The "debrief" is a tool crews can use to facilitate discussion on what they did right and what they did wrong. Effective debriefing occurs when an individual correctly identifies past problems encountered in any given mission, correctly identifies the root cause, identifies a method for solving the problem, and assesses whether mission goals were accomplished. More often than not, debriefing is conducted in an

instructional environment with the student debriefing first, followed by the instructor of record. Yet, the value of debriefing achieves results in any environment, especially, the environment the tactics flight finds itself in.

As stated earlier, several parts combine to form a debrief: the problem, the root cause, the lesson learned, and assessment of mission accomplishment. To understand debriefing, let's take a look at an example.

Early one morning, wing scheduling calls the squadron scheduling shop to notify them of a change to an upcoming satellite navigation upload. The squadron scheduler dutifully jots the message down on a "sticky" and presses on with the day's business. The support isn't until the next day, Saturday. With the day coming to a close, the scheduler proceeds to the operations floor and updates the scheduling binder-- without briefing the crew on duty. At shift change, the off-going crew fails to brief the on-coming crew. Consequently, the oncoming crew fails to properly plan for the support. Saturday rolls around and ground controllers call the operations floor to begin preparing equipment for the support. Caught off guard, the crew is unable to perform the support. Let's debrief it.

Problem	**Root Cause**	**Lesson Learned**
"What Happened"	"Why"	"How do we fix it"
Scheduler jotted change down on "sticky," not approved schedule change request form	Didn't know about the form. Why? Not fully trained. Why? Squadron policy allows untrained schedulers to perform scheduling duties.	Correct training plan to reflect that only fully trained schedulers are authorized to perform duties. Brief personnel on this change.
Updated binder without briefing the crew.	See above Scheduler Crew commander didn't follow schedule deconfliction checklist. Why? Felt it was the on coming crew's duty. Why? Didn't realize that a Crew Information File (CIF) was posted changing the procedure. Why? Poor checklist discipline. Crew changeover requires personnel to read CIF's.	Identify as an interest item in the Changeover Brief and emphasize checklist discipline in the simulator. Review crew commander's records and have instructors assess checklist discipline on the individual's next simulator.

With the debrief almost complete, let's examine whether the crew met our mission goals. Did the crew complete the satellite navigation upload? **No!** An easy way out is to blame the scheduler. However, the crew commander failed to perform required checklist actions. Consequently, the mission goal for accomplishing the support and meeting user needs is rated a failure. The scheduler may also claim ignorance on the training policy. However, the scheduling office's mission requires them to produce a product (approved schedule change form) to meet the squadron mission. The particular scheduler did not accomplish the mission.

Bottom line: The mission was not accomplished and the impact on supported operations was real—and possibly catastrophic.

After an exhaustive debrief, discussion begins to focus on the support that wasn't accomplished. In close coordination with the squadron, the tactics flight reviews the number of satellite navigation uploads performed daily. After further evaluation, side discussions reveal the satellite navigation uploads could be more effectively coordinated prior to a "rise" over a critical AOR. By the end of a long day, a rough "idea" for a new tactic is taking shape: reduce the number of satellite navigation uploads and coordinate the upload X amount of time before rise over critical AOR.

Debriefing fixed a faulty procedure and created an "idea" that might make it to a tactic!

Effective debriefing is a skill. To become proficient, debriefing requires practice and the ability to self-critique. Part of debriefing is also identifying the positive in an individual or organization. Take time to notice exceptional performance and recognize good work. Here are some situations where a debrief is a must:

1. Debrief a classroom lesson plan presented by an instructor.
2. Let a crew debrief a simulator scenario and assess their performance.
3. Following a squadron exercise, debrief the crew force.
4. Identify the "road ahead" following a conference.
5. Analyze that problem that just keeps cropping up in the squadron!
6. Debrief at crew changeover.

Debriefing is a healthy process. Practice it and make it part of your tactics flight.

Be Flexible

"*One of the first postwar planning tasks of Hap, Tooey, Ira, and many others at the Pentagon was to push for legislation to set up a Department of National Defense with a separate Air Force on equal basis with the Army and Navy.*" (General James Doolittle, 465)

Some of our Air Force's greatest leaders and teachers embodied the "Be Flexible" concept: Hap Arnold, Ira Eaker, Jimmy Doolittle, and Tooey Spatz to name a few. With this heritage, the flight's role as a leader within the wing, and its inherent responsibility to "teach," a robust tactics process is required to keep the wing focused on its mission and its reason for being --- AEROSPACE DOMINANCE.

Space and missile "tactics" are now incorporated in Air Force Tactics, Techniques, and Procedures (AFTTP) 3-1, Volume 28. Incorporating our processes into the AFTTP program is a new step for the space and missile community; but more importantly, it is the right step. Yet, just like any other product, it serves no purpose unless it is used, reviewed, critiqued, and supported.

Great! A tactics flight is created at the wing. The Air Force incorporated space and missile tactics in the AFTTP 3-1 series. But how does the tactics flight get a new idea recognized? The tactics improvement process is the answer. Let's take a closer look at the process (see Fig 1).

TACTICS IMPROVEMENT PROCESS (TIP)

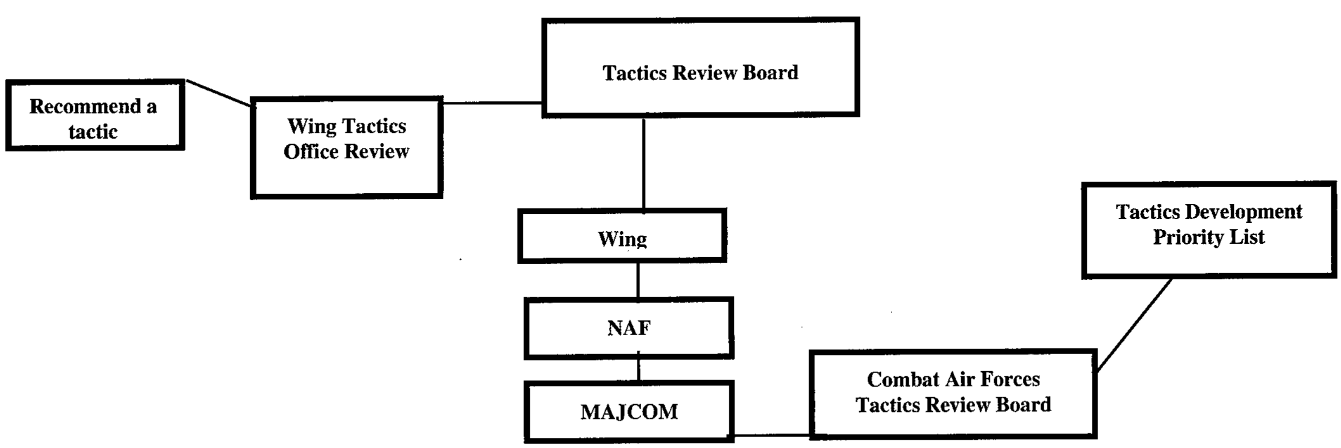


Figure 1: ***Tactics Improvement Process***

How do we get this process rolling? Operators at the wing submit inputs. Your crew might be pulling shift one night and decide, "Hey, a better way to accomplish satellite navigation upload is . . ." or "You know, the troops we're supporting in the field are requesting X type of support. A more expedient way to get the data to them is. . ." The intent is that your input becomes a new or improved way of accomplishing your mission. The wing tactics flight is going to consolidate inputs and should be helping you craft your input.

The Tactics Review Board (TRB) analyzes all proposed tactics from the subordinate levels and acts as a filter for the next echelon in the chain of command. The MAJCOM TRB is the final reviewing echelon. MAJCOMs will consolidate and forward inputs to the Combat Air Forces (CAF) TRB for final approval. The CAF TRB will take all approved inputs and create a Tactics Development Priority List (TDPL). For the fiscal year, the TDPL will prioritize inputs for the test and evaluation community, as required. As the process moves up the chain of command, the process also focuses on moving the tactic from development to employment (see Fig 2).

Tactics Lifecycle – Development to Employment

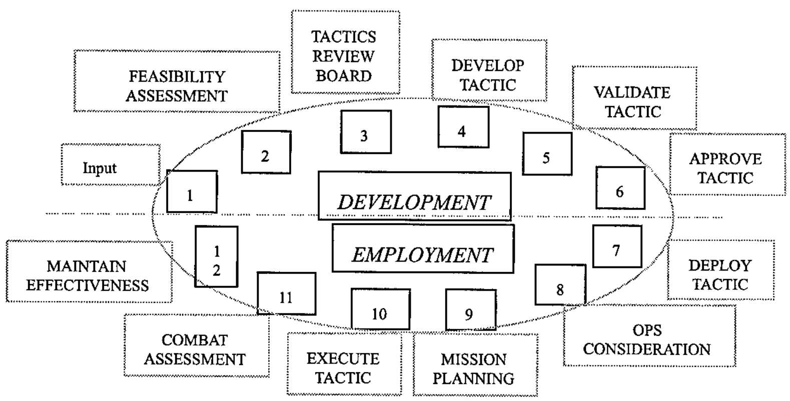


Figure 2: *Tactics Lifecycle*

Does it really matter if I submit an input? As an operator employing aerospace power in-theater, I know the tactics created by the space and missile community make a difference. When developing an input, look at three facets—effect on the mission, impact to the users and impact to the space community (your satellite system and others). If there is a better way to accomplish the Global Positioning System (GPS) mission, it pays off for the GPS community and the warfighter. Similarly, if there is a more efficient way to execute theater missile defense support, troops in contact with our adversary will benefit as well as the civilian populace. The program is only as strong as the tactics flight makes it.

Maximizing our stay in the "Quiet Sector"

"The end for which a soldier is recruited, clothed, armed, and trained, the whole object of his sleeping, eating, drinking, and marching is simply that he should ***fight at the right place and the right time.****"* (Clausewitz, On War)

With a limited amount of time on our side, the tactics flight needs to focus its efforts on building a strong program. A program designed to answer age old questions: "Where is the right place to fight?" and "When is the right time?" Also, a program required to confront the challenges of modern warfare: "How effective was my strike?" "How can I make a smart weapon even smarter?" and "What is the adversary's intent?"

To form a strong tactics program capable of confronting the challenges of modern warfare, I'd recommend making some in-roads with the users of your wing's systems. Methods to achieve in-roads might include some of the following initiatives: TDY to user location, user visit to satellite ground station, reviewing other systems (F-15E, F-16, RC-135J) AFTTPs 3-1 and 3-3, and observing exercises. When the user need is understood, put the flight into action, motivate the crew force, and watch what happens.

Making in-roads with the user is only one part of the equation. The tactics flight needs to take a look at tactics that improve space operations for space operations sake. For example, are there possible tactics which may accomplish routine operations procedures in a more efficient manner? Efficiency will translate to potentially less range time. Additionally, how many satellite states of health do I really need to do in a week? Reworking nominal supports like states of health may open range time up for other systems or decrease user downtime. With a robust tactics improvement process in place at the wing, the possibilities for improvement and increased support to the full spectrum of military operations are endless!

CONCLUSION

"One who excels at warfare first establishes himself in a position where he cannot be defeated while not losing any opportunity to defeat the enemy." (Sun-Tzu, 57)

As tactics officers, we must excel at all facets of warfare--tactics, strategy, and planning to name only a few! For space tactics to become a reality, three key ingredients are required: the ability to lead, teach, and be flexible. To achieve these objectives, the flight needs to reach several milestones on its road to mission accomplishment.

As discussed, the flight must establish its leadership role. To that end, the flight needs to set a vision or long range strategy in place to achieve objectives. This paper discussed several rules of leadership. Again, the #1 rule focuses on establishing a vision and being demanding. With this as a guide, the flight is well on its way to establishing its leadership position in the wing.

Part of leadership is the ability to teach. An indispensable teaching skill for the tactics flight is the ability to debrief. Debriefing is comprised of several key elements: correctly identify past problems encountered in any given mission, correctly identify the root cause, identify a method for solving the problem, and assess whether mission goals were accomplished. By keeping these elements in mind and debriefing recommended events discussed earlier, the tactics flight will find itself "out-front" sharpening the wing's combat capability.

A key to tactics flexibility is the tactics improvement process. It is the third ingredient in making space tactics a reality. The tactics improvement process involves operators and users at all levels. As stated earlier, the tactics improvement process is the culmination of the other key ingredients--leadership and teaching. Without the ability to lead and teach, the tactics flight will find it difficult to implement a strong process and remain flexible to the needs of the wing and the warfighter.

While space spends "the three-month stay in the 'quiet' Toul sector," space and missile operators must take the time to build the tactics foundation that will carry us across the full spectrum of military operations in our next major conflict or contingency. Key to a solid foundation is the tactics flight's ability to successfully LEAD, TEACH and BE FLEXIBLE!

BIBLIOGRAPHY

1. Clausewitz, Carl Von. On War. Edited and Translated by Michael Howard and Peter Paret. Princeton University Press. Princeton, New Jersey, 1976.
2. Hudson, James J. Hostile Skies: A Combat History of the American Air Service in World War I. Syracuse University Press. Syracuse, New York, 1968.
3. Powell, Colin. My American Journey. Random House. New York, New York, 1995.
4. Sawyer, Ralph D. The Seven Military Classics of Ancient China. Westview Press. Oxford, England, 1993.
5. Stockdale, Jim. Thoughts of a Philosophical Fighter Pilot. Hoover Institution Press. Stanford, CA, 1993.

GLOBAL REACH/PRECISION ENGAGEMENT

Maj Ed McCarty, HQ AFSPC/DRMF, DSN 692-6162

Future planning for the employment of the Aerospace Expeditionary Force (AEF) may include systems such as the Conventional Ballistic Missile (CBM) and Space Operations Vehicle (SOV). These sytems are capable of neutralizing the most difficult targets. They will allow the AEF to cope with asymmetric and unconventional situations by providing an additional means to fulfill requirements for military global reach and precision engagement. Hard and deeply buried targets, relocatable targets, weapons of mass destruction storage and employment areas and time sensitive targets are missions ideally suited for a CBM or SOV. The hypersonic speeds and maneuvering capability of the reentry vehicles deployed from a CBM and SOV assure defense penetration with minimal over flight. This capability eliminates the risk to operators by not putting aircrews and observers in harm's way by all but completely avoiding threat rings and point defenses. Additionally, the accuracy and all-weather capability of the weapon system provide discriminate force precisely where required while limiting collateral damage and achieving the desired effect.

Air Force Space Command, along with its partners in the Space and Missile Systems Center and the Air Force Research Lab, is preparing a demonstration of this long-range precision strike capability during the fourth quarter of 2001. A modified surplus ballistic reentry vehicle (Mark 11C) will be launched from Vandenberg AFB to the Kwajalein Missile Test Range aboard a Minuteman ICBM. The Mark 11C will be equipped with a GPS receiver coupled to an inertial measurement unit. The reentry system will be able to perform guidance corrections through a moving mass control system in concert with a jet reaction control system to provide an extremely high degree of accuracy. Central to the design will be an earth-penetrating weapon for hard target kill. To date, the penetrator design has been tested twice at the White Sands Missile Test Range with penetration of around 40 feet in fractured granite. Other components of this system to include high explosive, fuze, heat shield, GPS and antenna designs have been undergoing concurrent development.

The follow-on to the Mark 11C is the Common Aero Vehicle (CAV). It will have the capability to deliver a suite of force application mission payloads to any corner on Earth from either a CBM or SOV. Like the Mark 11C, the CAV will have the attributes inherent in hypersonic vehicles, but greater glide and maneuvering capability due to its higher lift of drag ratio. Weapon loads could include sensors, micro-satellites and state of the art munitions such as earth penetrators, small smart bombs and small autonomous attack weapons. A CAV demonstration could be performed as early as 2004[1].

As a key enabler to halting the attack and achieving rapid dominance, the Mark 11C and CAV bring to the fight a unique suite of capabilities ideally suited to counter new and emerging threats. Capable of rapidly projecting combat power anywhere in the world without being physically based everywhere in the world places the adversary's forces under constant threat of attack.

---

[1] USSPACECOM Long Range Plan. Colorado Springs, CO: US Space Command, Mar '98

INTELLIGENCE PREPARATION OF THE BATTLESPACE AND ATTACKING TIME CRITICAL TARGETS

Col Edwin Hawkins, HQ AFSPC/IN, DSN 692-3807

In the summer of 1944, a series of strange phenomena began to be observed and reported in the Western United States. People reported seeing large balloons and hearing explosions during the day and seeing flashes at night, which could not be explained. After authorities pieced the information together, they discovered that the reports were due to balloon-borne bombs that suddenly appeared in the Western US. Thus began a long period of detective work to determine exactly where the balloon bombs originated from, culminating in a successful attack against their launch sites. The analysis concluded that the balloon bombs actually originated in Japan and that the Japanese were using a newly discovered phenomenon called the Jet Stream to deliver them to the continental US. Having no other way to deliver bombs over such distances by air, the Japanese had resorted to this low-tech means for attacking the continental US, a 1940s example of an asymmetrical warfare weapon. A key piece of evidence turned out to be the sand in the balloons' ballast bags, which pinpointed the exact beach area from where the balloons were launched. The detectives analyzed the balloon infrastructure to identify its center of gravity, the hydrogen producing plants which provided the lifting gas for the balloons. Aircraft were sent to bomb the hydrogen plants, and almost immediately the balloon attacks ceased.

The analysts performed a precursor of today's IPB process--Intelligence Preparation of the Battlespace. IPB enables us to leverage information about an adversary's capabilities, potential centers of gravity, and possible courses of action across all dimensions of the battlespace.[1] In past wars, such as the WWII example above and even more recently in the Gulf War, analysts generally followed a traditional analytical process. The process analyzed a problem set and then identified targets for destruction. As time went on and more information became available, analysts were able to discern more of the adversary's capabilities and predict the adversary's courses of action.

The IPB process today focuses on providing predictive intelligence, surveillance, and reconnaissance (ISR) information to warfighters at the right time for use in planning and executing operations. Nowhere is this as important as with attacking time critical targets (TCT). Weapon systems such as theater ballistic missiles can be fired with little or no advance warning and relocate within minutes of firing. Today and in the future, we must perform IPB up front with robust ISR.

IPB transitions you from the regime of reactive to the regime of predictive. With IPB, analysts anticipate how an adversary will use its weapon systems, look for and detect deployment signatures, and then position our own forces so we can attack them with minimum reaction time. In other words, we could pre-position our strike aircraft in areas we expect the adversary to deploy their assets and when the asset is detected, the time required to put a weapon on that target can be reduced significantly. The result: is a higher probability the target will be attacked before it moves.

Now fast-forward to a notional conflict in a third world area--Korean Peninsula, Persian Gulf, or South Asia. We perform IPB and have a good understanding of an adversary's mobile missile employment tactics. We know the hide sites, weapon system signatures, and employment tactics. The first piece of intelligence information will cause a cascade of related assumptions and conclusions on missile employment. Using this information, commanders position attacking assets near predicted employment/launch points. If all works out, the attacking assets are directed against the missiles before they are able to launch. Even if the adversary is able to launch a missile, our strike assets will be in position to deliver a crushing blow before the missile launcher can pack up and move.

As weapons of mass destruction and the means to deliver them continue to proliferate IPB becomes critical for understanding how these countries plan to employ them. With good IPB, we can stop them before they take action against us. That is the power of IPB.

[1] USAF/XO White Paper on IPB

SPACE WARFARE CENTER BRINGS REAL-TIME INFORMATION INTO THE COCKPIT (RTIC) FOR THE B-1 DURING EXPEDITIONARY FORCES EXPERIMENT (EFX) '98

Maj David Thomson, HQ SWC/DO, DSN 560-9351

The B-1 does not have to rely on 8- to 12- hour-old weather, intelligence, target and threat information as they fly and execute the GLOBAL POWER intercontinental strike missions any more. Within an Area of Responsibility (AOR), it can prosecute assigned targets while receiving near real-time Airborne Warning and Control System (AWACS) data, threat and target imagery. This is all accomplished through the Multiple Source Tactical System (MSTS) and TRACK II systems demonstrated in EFX '98. EFX '98 is a Command and Control (C2) experiment bringing critical information to both combat leaders and shooters. The leadership makes faster decisions with respect to the conflict while shooters receive the same information inside the cockpit. The result is more timely and accurate weapons on target with increased survivability of aircrews.

TRACK II is a "snap-on" UHF SATCOM communications suite that provides C2 and intransit visibility through aircraft tracking, position reporting, aircraft loadout, and two-way E-mail. It utilizes a multi-channel receiver and integrated displays of both national and tactical combat information for in-flight situational awareness. The multiple intelligence and information sources are overlaid in near real-time onto digital country outlines, navigational charts and multi-spectral imagery. TRACK II allows two- and three-dimensional flight following target area analysis, space support analysis and mission fly-through or rehearsal.

The MSTS is an informational and display system that provides RTIC to the B-1. It is comprised of 110 pounds of "strap-on" technology allowing the B-1 to receive inflight information via UHF line of sight and/or through Air Force Satellite Communications System (AFSATCOM). The AFSATCOM relay provides the B-1 with over-the-horizon information reception capability. Internal to the MSTS system is chart information with capability to overlay the flight plan profile.

A multiple window, multi-tasked, user friendly environment that minimizes operator set-up and "button pushing" provides situational awareness information to the B-1. For the multi-mission environment, multiple aircraft routes can be simultaneously tracked in multiple AORs. Interactive perspective views provide mission rehearsal, mission following and recovery monitoring. Correlated displays provide off-board, over-the-horizon sensor warning for ongoing and planned military operations.

The B-1's lone penetrator mission is enhanced through improved situational awareness from off-board information received over the horizon. Combining TRACK II with MSTS is to provide en route space products (e.g., reconnaissance, surveillance and navigation) to en route aircraft and aircrews. The B-1 serves as a mission commander receiving and relaying critical targeting and threat data when it is imbedded in a Combat Air Forces strike package. The stage for this enhancement is set by EFX. EFX is a major step toward Air and Space integration and bringing AeroSpace power to the 21st Century.

WHAT'S THAT IN THE NIGHT SKY?

Capt James Trimble, SB/SBA, DSN 560-9381

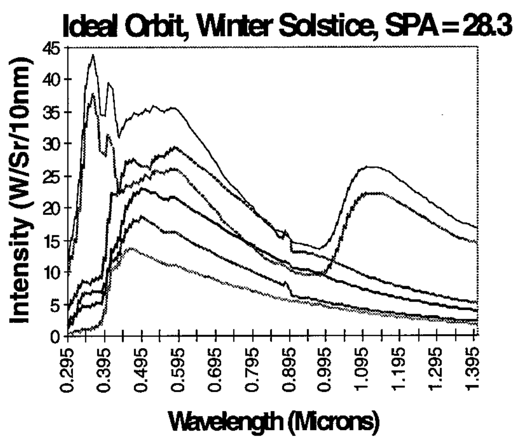
Have you ever looked up into the night sky and wondered what that moving speck of light was? If you have, you're not alone. US Space Command (USSPACECOM) and AF Space Command (AFSPC) also want to know. It's their job to keep track of thousands of space objects orbiting the Earth.

Keeping track of Earth orbiting space objects is a complex job. USSPACECOM and AFSPC spend millions of dollars and man-hours just keeping up with the ever-growing population of satellites orbiting above Earth. There are hundreds of variables that change with each satellite orbit. One of the more challenging orbit types to track is deep space objects because there are so few sensors that can positively identify deep space satellites.

Even with the most powerful telescopes such as the Ground-Based Electro-Optical Deep Space Surveil ance (GEODSS) System, pictured at right, you cannot see the satellite well enough to tell one satellite from another. All you can see is how much white light is being reflected from the satellite. That light can give you a measure of the gross stability of the satellite (i.e., whether the satellite is stable, rotating, or out of control).
That is not a lot of information to go on if you really want to positively identify the satellite.

Recently, the AF Space Battlelab (SB) kicked off an initiative that may shed new light on the subject. Since the 1980s, Space Object Identification (SOI) experts determined there might be a way to fingerprint deep space satellites by their spectral color (Figure 1.) When Allen Schemezel of the AF Research Laboratory brought the idea to the SB's attention, the SOI In Living Color (SILC) Initiative was born. The SILC Initiative explores the military utility of filtering white light collected by GEODSS and trying to define deep space satellites by their spectral signatures. In other words, can the US military identify deep space objects by breaking down white light into different colors in the visible light spectrum?

If the SILC demonstration proves successful, it will be the first time the GEODSS will be able to fingerprint deep space objects. This would be revolutionary in space object identification. It would change post collection analysis and dramatically improve the accuracy of satellite identification and analysis. Initial implementation operations and maintenance cost estimates for SILC are very promising.



Example of Spectral Breakdown of White Light

Figure 1

While SILC is just beginning to collect data, it has great potential. The initiative is but one example of how SB is looking at technologies and missions in new ways. SB is continually looking for new ideas to break the status quo of "that's how we have always done it." If you have an idea on better ways to use space please contact us.

Mailing Address
AF Space Battlelab
730 Irwin Ave, Ste 83
Schriever AFB, CO 80912-7383

Web Address
www.schriever.af.mil/battlelab/

E-Mail Address
spcbtlab@swc.schriever.af.mil

Telephone
DSN 560-9392
(719) 567-9392

FAX
DSN 560-9937
(719) 567-9937

YEAR 2000 OPERATIONAL EVALUATIONS

Capt Steve Lewis, 17 TS/TEK, DSN 560-8255

As the world draws nearer to the millennium, the 17th Test Squadron is immersed in efforts to ready USSPACECOM for what the CINC has decreed as the number one priority vice combat operations or safety: Y2K. The lion's share of the squadron's resources has been dedicated to the cause, shelving other important testing as a result.

Unified commanders are conducting end-to-end testing of the "thin line" or minimum number of systems required to accomplish mission-critical tasks building confidence that they can perform their missions in a Y2K environment . The thin line stretches from the command and control element of a mission process to the end-user. Depending on the thin line, an end-user could be a soldier with a Global Positioning System receiver or a huge weather forecasting agency. This end-to-end testing of the thin lines is called an Operational Evaluation (OPEVAL).

An OPEVAL's purpose is to determine if critical tasks in a mission can be accomplished in conjunction with each other, as opposed to all the parts of a system working independently. The goal is to test a CINC's ability to accomplish a mission, not to do a systems test. OPEVALs differ from systems tests in that they must consist of previously Y2K-certified subsystems.

Another important difference between an OPEVAL and a Y2K systems test is that an OPEVAL introduces actual operators, operational systems, end-users and contingency plans into the mix. The use of live systems, as opposed to mock-ups or test beds in a controlled environment, provides a greater degree of confidence in the test data. This is step two in the testing philosophy of first conducting controlled environment tests and then introducing operational environment variables.

Each CINC was given a time frame to conduct their OPEVALs with NORAD following a schedule that began in February covering integrated tactical warning/attack assessment and aerospace control. USSPACECOM executed a space control and surveillance OPEVAL in March and will participate in a USCENTCOM OPEVAL from 1 Apr 99 to 15 May 99. The lone remaining USSPACECOM thin line, space lift, will execute in the Jul-Aug-Sep time frame.

USSPACECOM assets supporting USCENTCOM operations include communications, navigation, theater ballistic missile warning, satellite command and control, and space and terrestrial weather. Each thin line was assigned a test program manager who, in turn, formed what is called a Test Plan Working Group (TPWG). TPWGs consist of subject matter experts and points of contact from all concerned agencies and headquarters. Their size is dependent on the characteristics of the test in question. These separate TPWGs have converged on three occasions for planning conferences to aid in coordination and to give the commands a comprehensive take on how the process is shaping up.

Because of the enormity of the task, participating assets spanning the globe, and the uniqueness of OPEVALs, planning for USCENTCOM support has been challenging. The 17 TS and everyone involved have definitely stepped outside of their comfort zones to make this historic project a success.

One peculiarity of OPEVALs, from the 17 TS perspective, is they are a one-sample test. Normally a test gathers a representative sample of observations from which conclusions are drawn. With OPEVALs, each of the three Joint Staff-directed Y2K dates will receive one execution; essentially a one-shot pass/fail determination. This is appropriate because of the impetus behind the test: the desire to have a confidence check on our certified systems.

Y2K is and will be at the forefront of our community's thoughts and concerns for some time to come. Because of the extraordinary efforts that have been set in motion to engage this problem head on, we expect our country's space forces to continue to deliver when the clock turns 2000.

MIDCOURSE SPACE EXPERIMENT (MSX)

1st Lt Mike Halick, 1 SOPS/DOUAR, DSN 560-5373

The Midcourse Space Experiment (MSX) observatory is a Ballistic Missile Defense Organization (BMDO) project that offers major benefits for both the military and civilian sectors. MSX represents the first system demonstration of technology in space to identify and track ballistic missiles during their midcourse flight phase. The spacecraft features an advanced multi-spectral image capability to gather data on test targets and space background phenomena. MSX will aid future spacecraft design by monitoring on-orbit contamination of optical instruments. In addition, its investigation of the composition and dynamics of Earth's atmosphere promises increased understanding of the environment.

The Sensor Technology Directorate (STD) of BMDO has overall responsibility for MSX. The Johns Hopkins University Applied Physics Laboratory (JHU/APL) serves as systems engineer and technical adviser. JHU/APL is under contract to BMDO to develop, integrate, test, launch, and operate the MSX spacecraft and several of its primary sensors.

MSX was launched aboard a Delta II booster from Vandenberg AFB, CA in March 1996. Insertion altitude was approximately 900 km in a high-inclination, circular, near-sun synchronous orbit. Mission design lifetime was 4 years. The lifetime of the primary payload, Spacial Infrared Imaging Telescope III (SPIRIT III) was limited by its coolant supply which was depleted June 1997. Approximately 50% of MSX's weight and power were allocated to instrument use. The SPIRIT III payload was designed to gather data on backgrounds and to detect and track test ICBMs launched from the Western Test Range (WTR) and targeted at the Kwajalein Missile Range in the Pacific Ocean. Other target objects included ballistic missiles launched from Barking Sands in Hawaii, orbiting satellites, and spherical objects deployed from MSX itself. The current "post-cryogen" phase is demonstrating space surveillance, a significant feature unique to MSX.

MSX provides unique opportunities to observe man-made debris in Earth orbit by searching known debris streams for unknown objects, observing the dispersal of fragments after the catastrophic destruction of a resident space object, and detecting objects that may be on or close to collision orbits with MSX. Above an altitude of 500 km, knowledge of man-made orbital debris is incomplete for debris 10 to 30 cm in diameter and largely unknown for debris less than 10 cm in diameter. MSX's orbit height of 900 km is where current models predict the greatest amount of man-made debris in low earth orbit.

The MSX Mission Operations Center (MOC) is located at the JHU/APL in Laurel, MD. The MOC is responsible for primary operations planning, control, and spacecraft performance assessment. The Research and Development, Testing and Evaluation (RDT&E) Support Complex (RSC) at Kirtland AFB, NM, currently provides tracking as well as command and control support using Air Force Satellite Control Network (AFSCN) resources. The 1st Space Operations Squadron (1 SOPS) at Schriever AFB, CO, had assumed RSC duties in December 1998. The 1st Command and Control Squadron (1 CACS) at CMAS, CO, currently uses the sensor data to catalog space objects. The MIT/Lincoln Laboratory is planning to perform some surveillance experiments.

With the mission moving from ballistic missile tracking to satellite tracking, Air Force Space Command (AFSPC), in agreement with the RSC, BMDO, and JHU/APL, decided that 1 SOPS at Schriever AFB will assume MSX command and control operations from the RSC. 1 SOPS is AFSPC's only satellite command and control squadron with the mission to control research and development satellites with residual capability to support the warfighter. 1 SOPS will continue the partnership with APL and 1 CACS by accomplishing 9-12 satellite contacts per day for on-orbit maintenance and vector determination. These operational sorties will consist of health checks, software uploads, and anomaly resolution.

MSX is the first-ever space-tracking platform based in space. Prior to MSX, tracking of space systems and debris was accomplished by the 21st Space Wing ground-stations scattered across the globe. With MSX, the Air Force has a tracking platform unaffected by weather and atmospheric conditions. When the cryogen phase of

the mission was completed, the focus changed to using the residual capability of on-board sensors to help track space objects. The Space-Based Infrared System (SBIRS) program is assessing the feasibility of using the same sensors for space object tracking for their future spacecraft. The Air Force is using the data from MSX to determine the benefits of space surveillance from a spaceborne platform. On 23 Jan 98, MSX provided space tracking data for the first time to 1 CACS, supplying approximately 200 more tracks per day to the catalog. Now, MSX is contributing approximately 400 tracks per day. Over the past 6 months, the number of lost objects has been halved and the average age of the catalog has decreased by 2 days. With these impressive results, MSX is clearly ushering in the next generation of space capabilities.

SPACE-BASED SPACE SURVEILLANCE OPERATIONS (SBSSO) ADVANCED CONCEPT TECHNOLOGY DEMONSTRATION (ACTD)

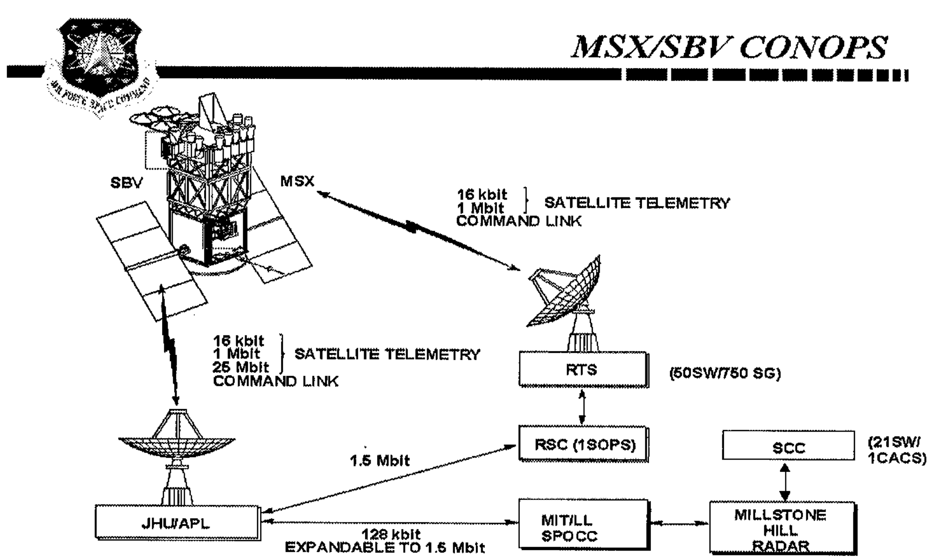
Maj Frank "Q" Williams, HQ AFSPC/DRFS, DSN 692-3273

The SBSSO ACTD is Air Force Space Command's first DoD-approved ACTD (1-3). It's approved for FY98-FY00 and is conducted in partnership with the Ballistic Missile Defense Organization (BMDO) and Office of the Deputy Under Secretary of Defense (ODUSD(AT)) (3-5). The demonstration uses the Space-Based Visible sensor (SBV) on BMDO's Midcourse Space Experiment (MSX) satellite (3-5).

The SBSSO ACTD uses the SBV to track, for the first-time, resident space objects (RSOs) from a space-based system for use in routine military operations (3-6, 8 and 11). BMDO retains satellite command authority which is executed by the Applied Physics Laboratory (APL), MD (5 and 6). However, Air Force Space Command (AFSPC) conducts space surveillance operations for eight hours per day, six days per week, 52 weeks per year (5 and 6).

MIT's Lincoln Laboratory at Hanscom AFB, MA is responsible for SBV operations and performs scheduled maintenance and/or additional development activities on the seventh day of the week. If maintenance or additional development isn't necessary, additional tracks are produced.

As a contributing sensor, the MSX/SBV is tasked by 1st Command and Control Squadron and provides the RSO tracks to US Space Command's Space Control Center (SCC) in the Cheyenne Mountain Operations Center, CO (5 and 6). These tracks are also provided to the Alternate SCC at Navy Space Command in Dahlgren, VA. The demonstration's concept of operations (CONOPS), illustrated below, led to the first-ever formal CONOPS for space-based space surveillance operations (5 and 6). The 1st Space Operations Squadron (1 SOPS) provides Remote Tracking Station (RTS) support (5 and 6).



The SBSSO ACTD is primarily designed to do two things. First, it's to mitigate the USSPACECOM "shortage of deep spacetrack capacity" (3-5 and 12). Second, it's to develop and mature a CONOPS and other lessons learned for future space-based space surveillance sensors like the Space-Based Infrared System (SBIRS) Low component (3-5). We cannot discuss the SBSSO ACTD without first getting an appreciation for the satellite it's based on. Thus, a brief summary is provided as background.

Background. On April 24, 1996 the BMDO launched the MSX satellite on a Delta II booster from Vandenberg AFB, CA (9). MSX was placed into a Sun-synchronous orbit at 898 km and an inclination of 99.16 degrees (10). MSX's mission is to gather data in three spectral bands (Long Wavelength Infrared (LWIR), visible, and ultraviolet) (10). Data collected with these sensors will establish the limits of our ability to acquire, track, and discriminate targets and decoys against the full range of terrestrial, earth-limb and celestial backgrounds (11). Data was collected during the Space Infrared Imaging Telescope (SPIRIT 3) operation (11). Analysis of this data will establish confidence in predicting LWIR and visible sensor performance through the entire midcourse phase of the Ballistic Missile Defense mission (11). Specific applications include current and future elements of the National Missile Defense program, particularly the SBIRS element (11). Results of this analysis will also validate key sensor technologies and establish their limits of performance in a realistic environment (11). The LWIR required cryogen cooling which only lasted for 10 months (10 and 24). In this post-cryogen period, the predominant MSX activity is the SBSSO ACTD.

Status. We're currently half-way into the demonstration period and we're achieving or exceeding all of our goals. Our original goal was to become a contributing sensor to the Space Surveillance Network (SSN) and produce 100 tracks (400 observations) per day (3 and 5). We became a contributing sensor on 13 May 98 (after a 30-day trial period that began 13 Apr 98). In October 1997 we were only producing about 50 tracks per day in our off-line development work. Through continuous improvement efforts we're currently (April 1999) producing 200 tracks (800 observations) per day. That's a four-fold increase from where we started! The official criteria for our success are documented in the Management Plan and consist of a single Measure of Effectiveness (MOE)(5):

Does space-based space surveillance support the Space Control mission to identify and maintain element sets of all earth-orbiting objects over 10 cm^2 and 1m^2 at GEO (5)? Yes.

This MOE is further broken down into six measures of performance (MOPs):

MOP 1: Are the satellite observations of the SBV of sufficient accuracy to support catalog maintenance (5)?

Yes. The SBV routinely tracks with an accuracy of +/- 4 arc seconds (13). By comparison, the Ground-Based Electro-Optical Deep-Space Surveillance System (GEODSS) A-Spec track accuracy is +/- 10 arc seconds (14).

MOP 2: Is the timeliness of the satellite observation receipt in the Space Control Center (SCC) sufficient (in accordance with SSN requirements) to support catalog maintenance (5 and 6)?

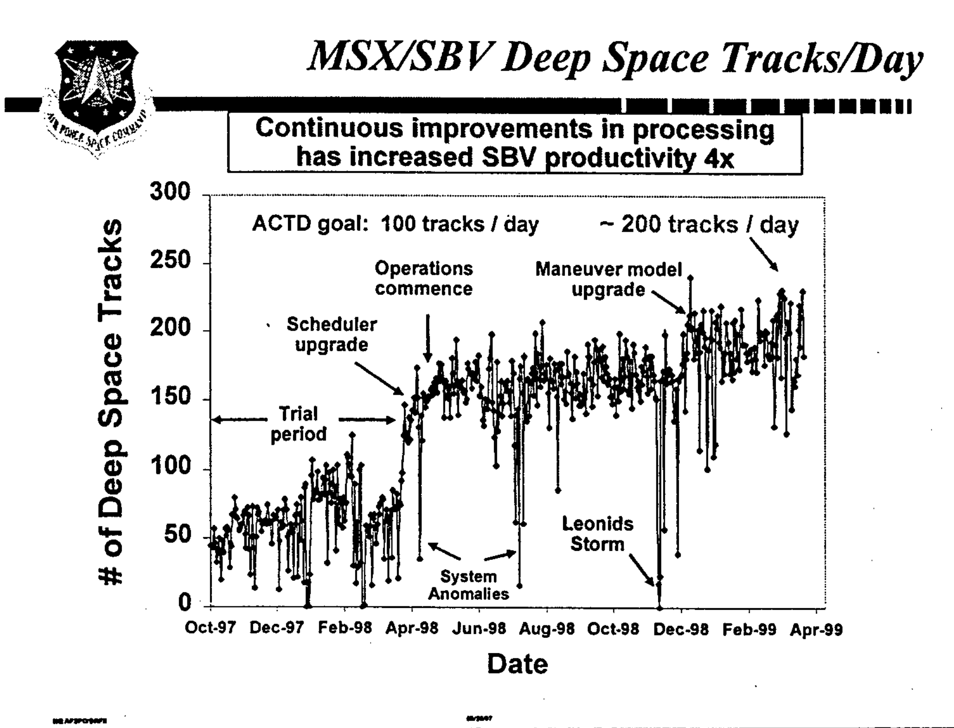
Yes. The MSX/SBV responds to tasking within 24 hours per the same requirements levied on ground-based systems (11).

MOP 3: Can the SBV efficiently respond to scheduled tasking from the SCC (5)?

Yes. And the SBV is more efficient at tracking Space Order of Battle (Category 1) objects. According to the most recent response to tasking metrics, SBV averages 93% in response to Cat 1 object tasking request (15). Ground-based sites range from 20-50% response to tasking on Cat 1 objects (15).

MOP 4: Are the observations of a space-based sensor of sufficient quantity to support Space Control mission objectives (5)?

Yes. See figure below.



MOP 5: Can the MSX/SBV search the GEO belt (5)?

Yes. MSX/SBV has already searched the entire geosynchronous belt (16). It's currently performing searches 2 hours/day, integrated with tasking (16). For tasked CAT 1 objects, the search is interrupted. Operators specify region of search. At 2 hrs/day, the entire belt is searched in 3.5 days (16). The maximum search rate is approximately 50 degrees per hour (16). MSX/SBV discovered 53 lost objects in the last 15 months (as of April 1999) (23 and 24). These objects were not in the US Space Command Satellite Catalog. Most of the objects were originally detected and reported as uncorrelated targets (UCTs). Upon subsequent tracking we found many of those UCTs were actually RSOs that had maneuvered or were perturbed out of the ground-based tracking source's field of view for tasking. And at least two of the UCTs turned out to be previously uncataloged objects that were discovered (23).

MOP 6: Do the additional observations decrease the age of the deep-space catalog from 4 days to xx days and decrease the average error at epoch for deep space objects from 25km to xxkm (5)?

Yes. Mr. Gil Miller at MITRE has independently verified the MSX/SBV has caused a 20% reduction in the average element set (Elset) age of deep space objects (17). The pre-SBSSO ACTD average Elset age was actually 5.0 days and has gone down to 4.1 days since the MSX/SBV began feeding real data to the SSN in April 1998 (17).

Future. DoD officials expect ACTDs to end in one of three states (1-3). The first is perhaps the easiest to deal with--failure (1-3). If an ACTD fails, the team packs up and goes away (1-3). This is clearly not the case for the SBSSO ACTD.

The second possible end state is harder to deal with--success (1-3). If an ACTD is successful and its CONOPS requires fielding a number of additional units--like the Medium Altitude Endurance Unmanned Aerial Vehicle (MAE UAV) or Predator--DoD officials expect a new acquisition program to start (1-3 and 8). The Predator UAV has been approved for acquisition and the 11th Reconnaissance Squadron has been activated at Indian Springs Airfield, NV (8). Unlike the MAE UAV, however, concepts for space-based space surveillance systems exist (i.e., Space-Based Electro-Optical Network (SBEON)) but they could cost \$300M-500M for a three-satellite constellation for up to 10 years (12 and 20). The operational space community can't afford this type of new system right now. So great concepts like the SBEON will stay on the drawing board until we either get more funds for new acquisitions or the cost

can come down considerably. Moreover, the SBIRS Low component may have a considerable space surveillance capability so a separate system may not be necessary (21).

The third possible end state is also for successful ACTDs but doesn't require a new acquisition program. This is where the SBSSO ACTD falls (1-3). Once an ACTD proves its warfighter utility, DoD officials expect a transition from demonstration operations to legacy operations with field-tested units (1-3).

Conclusion. The SBSSO ACTD is an unqualified success. The future is bright for post-ACTD MSX/SBV operations. At $7.1M per year, it costs a lot less than other space-based concepts for deep space tracking (3-5 and 20).

Its inherent advantages of greater metric accuracy and lack of weather or foreign base restrictions make it a logical choice for future operation (5 and 12). This is especially true since both of the SBIRS Low flight demonstration programs (FDS and LADS) were cancelled in February 1999 and the objective system (SBIRS Low) was delayed two years (first launch in FY06) (22). HQ AFSPC/DO makes it clear in his 9 Mar 99 letter to the Director of Requirements concerning the SBSSO ACTD that, he fully supports it through the full-term (FY98-FY00) but can't support follow-on operations at current cost (18). However, if we get some less expensive options for follow-on operations, he will reconsider. So our focus is shifting from maximizing tracks for the MSX/SBV to lowering operations cost over the next several months (19).

Acknowledgements. The Space Tactics Bulletin is published by the Space Warfare Center (SWC) so a few acknowledgements are in order. The SBSSO ACTD could not have begun in earnest without the SWC's Analysis & Engineering (SWC/AE) Division support. Their independent review of developer readiness to enter the demonstration, published in SWC/AE Technical Report 97-23, June 1997, was invaluable and verified the +/- 4 arc second accuracy of MSX/SBV metric data (14). The SWC's 17th Test Squadron also provided crucial support in the early phases of the demonstration by adding the MSX/SBV data to their ITW/AA testing at CMOC for no additional charge. This paved the way for the MSX/SBV data to get into the 13 Apr 98 trial period and certified by USSPACECOM/J6C for operations 13 May 98.

Bibliography

1. DoD 5000.2-R, 23 Mar 98, pp. 6-7
2. DUSD(AT) web site: "http://www.acq.osd.mil/at"
3. DUSD(AT) ACTD Master Plan, June 1998
4. SBSSO ACTD Implementation Directive, November 1998
5. SBSSO ACTD Management Plan, June 1998
6. MSX/SBV CONOPS, 1 Jun 98
7. HQ AFSPC OI 10-120104, 1 Sep 98
8. National Defense Magazine, 1998 Mega Directory, July/August 1998
9. TRW Space Log 1957-1996, 1997
10. Johns Hopkins APL Technical Digest, January-March 1996, Volume 17, Number 1
11. Johns Hopkins APL Technical Digest, April-June 1996, Volume 17, Number 2
12. Proceedings of the 1998 Space Control Conference, 14-16 April 1998
13. Space Surveillance Network Quarterly Metric Report, 1st Quarter FY99
14. Space Warfare Center Analysis & Engineering Technical Report 97-23, Analysis of the Accuracy of Metric Data from the Space-Based Visible Sensor on the Midcourse Space Experiment (MSX), June 1997
15. MIT/LL SBV Category 1 Performance
16. MIT/LL MSX/SBV Geosynchronous Search
17. MITRE Average Elset Age Data
18. HQ AFSPC/DO 9 Mar 99 memo to HQ AFSPC/DR on SBSSO ACTD
19. HQ AFSPC/DR 9 Mar 99 memo to HQ AFSPC/DO on SBSSO ACTD

20. Space Surveillance Sub-mission Area Development Plan (FY97), pp.13-17
21. SBIRS ORD (1996) Annex, 17 Jul 98
22. SMC/MT 5 Feb 99 Memo Terminating of SBIRS Low Demonstration (FDS/LADS) Contracts
23. Proceedings of the 1999 Space Control Conference, 13-15 April 1999, pp.175-188
24. Telephone Interview with Dr. Curt von Braun, MIT/LL Group 91, 16 Apr 99

WARFIGHTER SUPPORT FROM DEEP SPACE

Maj Russ Kutzman, HQ AFSPC/DRF, DSN 692-9140

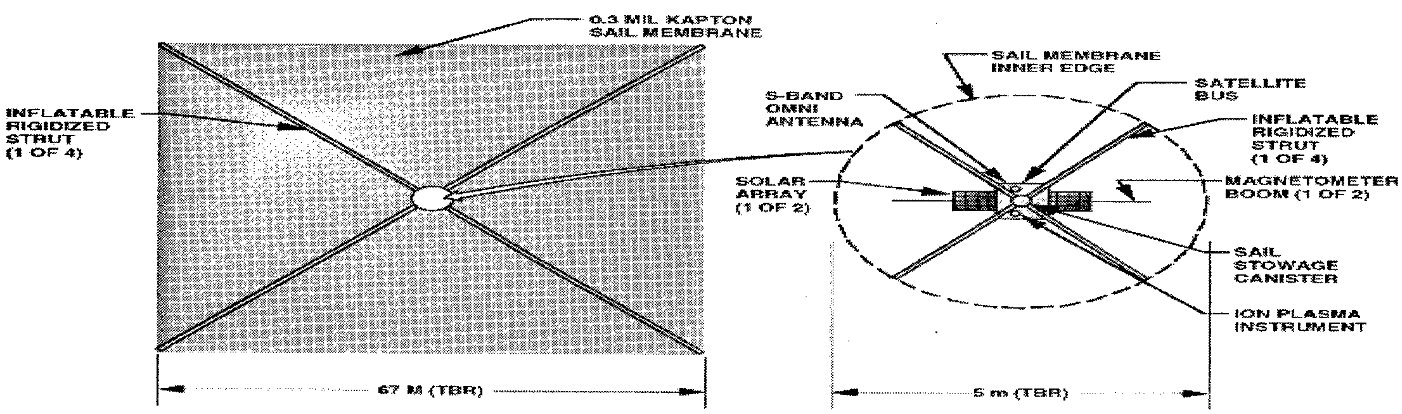
By now it is no surprise that an increasing level of military support is provided by ever-vigilant on-orbit satellites. From high speed communications, precise geolocation, and navigation signals, to early warning systems, we rely more and more on space assets high above the battlefield. But what is not so evident is the fact that these force multipliers can be crippled by unpredictable solar storms.

The sun continuously emits highly energetic particles across the entire electromagnetic spectrum. This is known as the solar wind. But occasionally the sun erupts with a violent burst of energy in the form of a solar eruption or solar flare. When this happens, huge amounts of energized particles, or plasma, are thrown into space. If the eruption occurs in the direction of the Earth, it may cause severe disruptions in the Earth's electric and geomagnetic fields and affect orbiting satellites.

These severe disruptions, called geomagnetic storms, in turn may cause HF radio communications to fade or be totally disrupted, satellite command and control signals and communications to be lost, GPS navigation to be severely degraded, and may even cause permanent hardware and software damage. These and other disruptions may occur virtually without warning and with potentially disastrous effects on battlefield operations.

Now help may be on the horizon, literally! In a joint Air Force Space Command, NASA, National Oceanic and Atmospheric Administration partnership effort, a unique solar storm warning satellite is planned. Called GEOSTORMS, this cutting edge technology microsat is scheduled to be launched as a technology demonstration project to monitor and warn of a solar event and impending geomagnetic storm. The satellite will be placed near the first Lagrangian libration point (L1), which is the gravitational equilibrium point between the earth and the sun.

Because of its special position, an additional goal of this project is to test solar sail technology as an advanced method of propulsion. Placed just sunward of the L1 point, at 0.98 astronomical units from the sun, the microsat will be subject to the sun's gravitational pull. But the 67-meter, square-shaped sail is designed to catch the solar wind and counterbalance the gravitational pull, thus maintaining the satellite's strategic position. This solar sail demonstration will help NASA evaluate its possible use for future interplanetary missions.



SAIL SATELLITE (TOP VIEW)

With the GEOSTORMS microsat near L1, it is roughly 80 times higher than earth geosynchronous altitude. At that distance it will provide 1-2 hours warning of a solar storm, nearly twice our current alert capability. That warning will allow space environment forecasters at the 55th Space Weather Squadron at Schriever AFB, CO, to send out worldwide alerts to warfighters and satellite operators. With sufficient warning operators can take some protective actions and theater commanders, with better situational awareness, can plan for possible system disruptions. It will enable an improved environmental assessment that directly augments the Air Tasking Order/Space Tasking Order (ATO/STO) process.

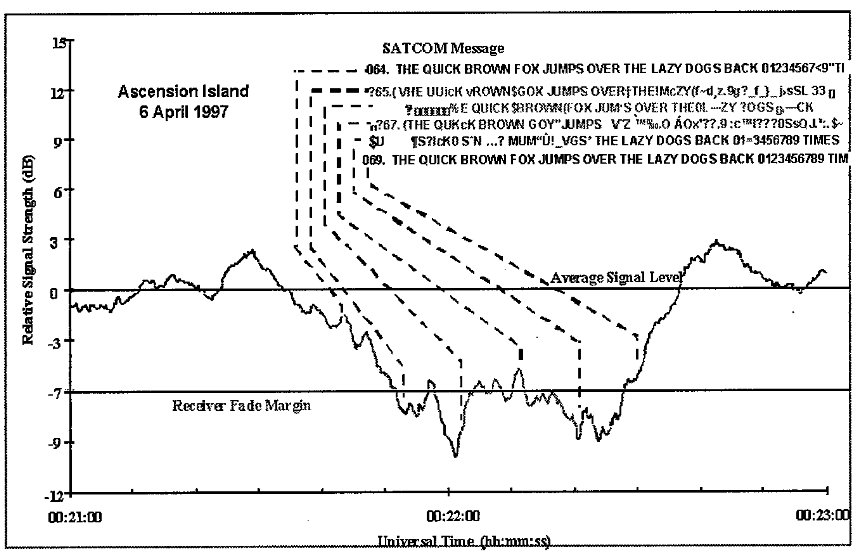
The GEOSTORMS program is currently on track with a planned launch in early FY03. Funding among the three partners is being finalized and launch option discussions are underway with the most likely candidate being a shuttle launch.

SCINTILLATION DEGRADATION TO SATELLITE SUPPORTED OPERATIONS

Capt Shawn D. Filby, 55 SWXS/DOUT, DSN 560-6228

As Air Force Space Command braces for the onslaught of Solar Maximum, single event upsets (SEU), spacecraft charging, and satellite disorientation are the focus of much attention. Although these should concern AFSPC, another less hazardous phenomenon will be enhanced during the most active time on the sun in eleven years--scintillation.

The scintillation of radiowave signals is the rapid, random variation in the signal amplitude, phase, and/or polarization caused by tiny scale irregularities in the electron density along a given signal path. Scintillation can cause signals to fade. It also can cause data drop-out on communication signals, data down-links, or satellite command up-links. The only way to detect the impact is when a signal path penetrates an ionospheric region where these small-scale electron density irregularities occur. Scintillation tends to be a localized effect. Geosynchronous communications with low latitude, nighttime links are seriously vulnerable to intermittent signal loss due to scintillation.



Scintillation rapidly affects communications signals, after its onset can last for several minutes to several hours.

For example, Global Positioning System signals may experience scintillation. GPS receivers can lose signal lock on a particular satellite from phase changes, signal strength enhancements, and fades. We have yet to find out the true scintillation vulnerability of the GPS constellation from solar activity. Since the GPS constellation received wide-spread use subsequent to the last solar maximum (11-year solar cycle), we don't know the maximum effects of scintillation.

Positioning errors can be introduced by the total electron content (TEC) along a GPS signal path. Free electrons in the ionosphere can cause higher frequencies used by GPS satellites to bend, similar to the bending of the HF radio waves. Passage through an ionized medium causes radio waves to slow down from the speed of light. The slower speed and the longer path length can introduce up to 300ns of error into a GPS location fix--unless some type of compensation is made for this effect.

The ionospheric irregularities that cause scintillation are most consistent in the post-sunset sector just north and south of the equator. These irregularities are enhanced when disturbances occur to Earth's magnetic fields, called geomagnetic storming. Geomagnetic storming increases in intensity and frequency at Solar Maximum, which is expected in the year 2000.

Scintillation is also strong at high latitudes such as the aurora latitudes and the polar regions. As in low-latitudes, the effects from this scintillation increase during geomagnetic storming. Knowing times of increased scintillation enables operators to reschedule activities and/or to switch to a radio frequency/satellite link that has less chance of being affected by scintillation.

There is no way of knowing exactly when and where scintillation may occur, but there are prediction algorithms designed to take into account solar activity and geomagnetic conditions. These algorithms forecast, with considerable confidence, when scintillation is likely to occur. The 55th Space Weather Squadron is the sole DoD organization which produces these forecasts.

The 55 SWXS currently provides several scintillation predictions tailored to specific users. These graphical products are available on a classified Internet site: http://www.55swxs.spacecom.smil.mil.

Contact the author at the top of this article for more information on scintillation, its effects or requesting tailored scintillation products.

THE LARGE VALUE OF SMALL ICBM

Capt Charles Williams, HQ SWC/XRTE, DSN 560-9519

Intercontinental ballistic missiles (ICBMs), the only current force applications system in Air Force Space Command (AFSPC), are vital United States space assets. The backbone of our ICBM force is the Minuteman III (MM III) weapon system. Unfortunately, this aging system is in immediate need of replacement or costly overhaul. Fortunately, the USAF foresaw this need and nearly completed the development of an ideal replacement missile: "Small ICBM."

You're now probably thinking, "News flash, author - the Cold War is over and we won." Yes, the Cold War is over, but are worldwide nuclear threats increasing or decreasing? Let's examine the missile capabilities and warhead stockpiles of nuclear powers in 1995:

Country Estimate[2]	Capabilities[1]	1995 Warhead Stockpile
US	ICBM, SLBM, SRBM	8500 strategic, 7000 tactical
Russia	ICBM, SLBM, SRBM	7200 strategic, ~10000 tactical
China	ICBM, SLBM, IRBM, SRBM	284 strategic, 150 tactical
England	SLBM	100 strategic, 100 tactical
France	SLBM, IRBM	482 strategic, no tactical
India	IRBM, SRBM	60+ nuclear devices
Pakistan	SRBM	15-25 nuclear devices

Israel	IRBM, SRBM	100+ nuclear devices
N. Korea	IRBM, SRBM	Not a confirmed nuclear power

1 SLBM = Submarine Launched Ballistic Missile
ICBM = Intercontinental Ballistic Missile (Range > 3500 NM)
IRBM = Intermediate Range Ballistic Missile (Range 1000 NM to 3500 NM)
SRBM = Short Range Ballistic Missiles (Range < 1000 NM)

2 **Source: *Tracking Nuclear Proliferation*, Carnegie Endowment for International Peace**

Since 1995, the US and Russia have continued to reduce their warhead stockpiles while nations such as China, India, and Pakistan have programs in place to rapidly expand their nuclear arsenals. In addition to a rising number of potential adversaries with ever increasing missile capabilities, consider this quote from Gen Welch (Ret.):

"It is the [ICBM leg of the Triad] whose value increases the most with declining forces. As the total numbers on both sides move from warhead rich to target rich, the single warhead silo based ICBM becomes highly stabilizing. It requires more than a 1:1 ratio for the attacker without commensurate impact on the broader target set." (Source: Report of the Defense Science Board Task Force on Nuclear Deterrence)

Based on these arguments, one could conclude that ICBM deterrence is *more* important now than ever.

An immediate concern for USAF ICBM weapon systems is the need to conform to the constraints of the START nuclear arms reduction treaties. If START II is ratified, the USAF will be required to make two significant changes:

1. Eliminate the Peacekeeper weapon system.
2. To maintain the nuclear triad, all multiple reentry vehicle (RV) ICBMs will be eliminated (all remaining ICBMs will be single RV).

If these changes were required tomorrow, the entire US ICBM force would consist of MM III missiles that are nearly 30 years old.

The MM III has performed great up to this point, but it was designed to last for 20 years, not 50. No system lasts forever. AFSPC will eventually replace the MM III missile; the question is when. The current plan is to replace MM III in 2020. To maintain the system for 21 more years, AFSPC must immediately replace major components. A guidance replacement program (GRP) is planned to begin this year, while a propulsion replacement program (PRP) is currently scheduled to begin in 2002. The projected cost of these two modification programs is $2.4B and $2B respectively. In addition to these programs, the ICBM System Program Office identified the MM III propellant system rocket engine as being in need of an expensive overhaul (projected cost of nearly $1B).

If AFSPC continues down this path, aging parts of the MM III weapon system will continually require replacement. These modification programs will cost additional billions of dollars. Thus, during the next twenty years, probably $8B - $15B will be sunk into maintaining MM III. An alternative to this scenario is to change course and build a new ICBM system, where all of the components are new. If this alternative path is taken now, in addition to eliminating the cost of modification programs needed to sustain MM III for 21 more years, the R & D cost for developing a new replacement weapon system can be avoided. This is because of the R & D that the USAF has already invested into Small ICBM.

Small ICBM is a canisterized, single reentry vehicle (RV) missile system that can be described as a small Peacekeeper missile. Its length, diameter, and weight are nearly identical to a MM III. Development of this weapon system was initiated in the late 1980s. When the program was suspended in 1991, Small ICBM was well past the "drawing board" phase. Two developmental flight tests of the missile were already conducted.

The design of the guidance set of Small ICBM closely resembles that of the Peacekeeper weapon system. Like Peacekeeper, Small ICBM is a much more accurate weapon system than MMIII, whose guidance set was designed in the 1960's.

With this increase in accuracy, Small ICBMs could target hardened facilities that must currently be covered by Peacekeeper, submarine launched ballistic missiles, or bombers. Another important benefit of the Small ICBM design is the highly energetic propellant of stages. This propellant results in a shorter flight time, especially during the powered flight phase of the flight. As a result, the weapon system has a more rapid response time and is less vulnerable to potential adversaries' missile defense system. The bottom line is that Small ICBM has significantly improved performance characteristics over the current MM III system.

Before the Small ICBM program was suspended, integration plans for placing Small ICBM into MM III launch facilities (LFs) had already been developed. Present MM III (LFs) could be converted to Small ICBM LFs relatively easily. As a side benefit, the necessary modifications would increase the hardness of each LF.

The estimated price tag for building Small ICBM and placing it in existing MM III silos is roughly $33B in 1999 dollars (Source: ICBM SPO). This includes modifying 550 MM III launchers, purchasing 550 Small ICBM missiles for alert, and building 140 additional spare missiles for testing. Besides the improvements in performance, Small ICBM will probably remain a viable system for at least 30 years (until 2030). As previously stated, AFSPC will eventually replace the MM III missile; the question is when. Developing a new ICBM system from scratch somewhere between today and 2020 will probably cost twice this amount, in addition to the billions which will be sunk into maintaining MM III until the new system is ready for employment.

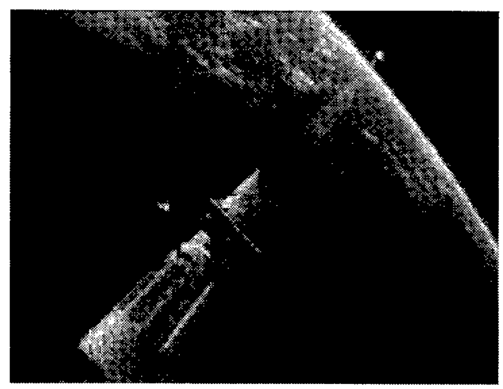
Consider this quote from President Clinton in May 1997:

"The United States must continue to maintain a robust triad of strategic forces to deter any hostile foreign leadership with access to any nuclear forces and to convince it that seeking a nuclear advantage would be futile."

As part of the critically important nuclear triad described above by our president, USAF ICBMs are indeed vital United States space assets. As such, Small ICBM is one option wisely being considered by HQ AFSPC planners to ensure that a capable and reliable ICBM system is maintained.

AIR FORCE SPACE COMMAND'S STRATEGIC MASTER PLAN

Maj Kreighbaum, HQ AFSPC/XPXI, DSN 692-5323



The Air Force Space Command (AFSPC) Strategic Master Plan (SMP) is the capstone blueprint that ties the space planning pieces together for achieving an AeroSpace Force. The plan provides a cost constrained, technologically feasible roadmap integrated across the AFSPC mission and mission support areas and documents a 25-year path to the future for AFSPC. If you're not familiar with the SMP it starts by describing a Vision of the possibilities--"Fully Integrated AeroSpace Systems Capable of Rapidly and Decisively Engaging Forces Worldwide." What this means is that we have a Vision and a roadmap to achieve that Vision. We used the 85 years of aerospace history to guide us. The seeds were laid by early airpower theorists and proponents who sensed the potential of "Global Reach, Global Power" before it was technologically feasible. Early space pioneers, looking beyond the novelty of space exploration, realized its potential for winning wars. The Vision grew and matured in the post Desert Storm environment, as the feasibility of aerospace dominance of the battlespace became reality.

The SMP begins to close the loop between aerospace theory and the technological, cultural and organizational advances required for making the AFSPC Vision a reality. In short, the SMP provides a long-range plan for reaching the Vision. It revolves around a strategy that considers the reality of our strategic defense environment--flat budgets and heavy operations tempo. It takes into account technology maturation times and political limitations on the military uses of space. The Strategy to implement the plan is feasible, but will require hard decisions.

Future AFSPC capabilities will enable a fully integrated AeroSpace Force to rapidly and decisively engage military forces worldwide. Space-based systems will continue to support and provide timely, flexible and precise global engagement of surface and airborne targets. Real-time, global situational awareness will be provided to all warfighting levels through space-based navigation, satellite communications (SATCOM), environmental monitoring (EM), surveillance and threat warning (S&TW) and command and control (C^2) systems. Cost-effective launch and satellite operations will be available to deploy and operate space assets at greater efficiencies. Full spectrum dominance in the space medium will be achieved through total space situational awareness, protection of friendly space assets, prevention of unauthorized use of those assets, negation of adversarial use of space and a fully capable national missile defense (NMD).

As a service we are on an evolutionary path to become a mature AeroSpace force. To get there, we will fully integrate our forces to dominate the vertical dimension--air and space. The Air Force provides our nation with the preponderance of power from this vertical dimension--air and space. These aerospace forces will enable us to conduct warfare in new ways, and defend American interests, both terrestrially and in space. The SMP outlines the integrated investment strategy which will strengthen the space segment and will serve as a guide to our Vision in the next century.

Interested in getting your own copy of the SMP? Contact HQ AFSPC/XPX at DSN 692-3263.

MILITARY UTILITY ANALYSIS: ANSWERING THE *"SO WHAT"* QUESTION

William C. McIntyre, SWC/AEA, DSN 560-9338

Have you ever considered what challenges a future space system (or any major DoD weapon system for that matter) has to go through in order to be fielded? One of the major hurdles all systems must "pass" during their development cycle is a Military Utility Analysis.

The objective of military utility analysis is to provide information and insights to senior decision-makers who must answer the "so what" questions involving force structures, operational concepts and military capabilities. In getting at the question, "What is the impact of this system on the warfighter?" military utility analysis attempts to measure the utility and effectiveness of military assets, forces, capabilities and operational concepts. To meet the information needs of these senior decision-makers, warfighting contributions must be placed in the context of large-scale applications of force within a battlespace of extensive time and scope.

The Force Analysis Branch, at the Space Warfare Center, Analysis and Engineering Division (HQ SWC/AEA) is using a variety of operations research methods to help answer the "so what" question. Value to the warfighter is often expressed in measures related to theater campaign success such as:

- number of days to achieve air superiority
- increase in number of friendly aircraft sorties
- number of theater ballistic missile (TBM) launchers destroyed
- territory lost prior to halting enemy advance

We use this information to support the HQ AFSPC Integrated Planning Process (IPP), analyzing tradeoffs in military utility versus cost for programmed and potential future systems, and building an optimal 25 year plan for space system acquisitions which maximizes military utility subject to budget, launch and other constraints.

One important way we generate the required measures of effectiveness is through the use of a variety of combat modeling tools with Campaign models being particularly important for our purposes. There are four general categories of models – engineering, engagement, mission, and campaign – employed by the modeling and simulation community. Which category a model belongs to depends upon its resolution, quantitative, and qualitative characteristics (see Figure 1).

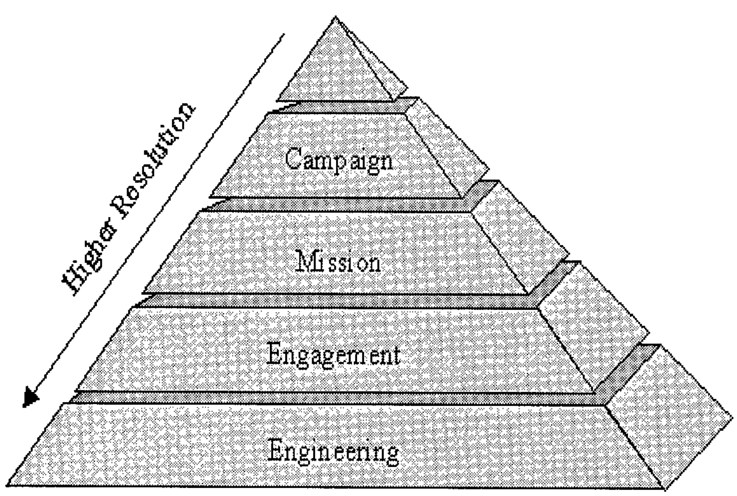


***Figure 1**. Model Hierarchy*

This hierarchy of models is used throughout the entire procurement process, from the requirements definition phase to how many systems to buy. Engineering/engagement models are typically used to evaluate a system's effectiveness against an adversary system. Mission models are typically used at the force-on-force level to assess the ability of particular platform force package or satellite constellation to perform a specific mission. Finally, campaign models are used to determine conflict outcomes for a total package of joint and combined forces.

HQ SWC/AEA military utility analysis quantifies the contributions of a system or capability to a theater-level campaign in measures that matter to the warfighter. Our primary tool for these analyses is the THUNDER model, the Air Force's premier, legacy campaign model. Though designed in the early 1980s to model a traditional (cold war) Central European campaign, THUNDER has been heavily modified in recent years to incorporate space systems as well as Intelligence, Surveillance, and Reconnaissance (ISR). AEA has played a significant role in championing space modifications to THUNDER. The THUNDER model itself will be replaced by the next generation AF campaign model, STORM, in FY01-FY02. AEA has helped formulate the Command's requirements for synthetic theater operations research model (STORM), and is pushing to be an early test site for STORM and participate in preliminary STORM studies. Also in the future is the Joint Warfighting Simulation, (JWARS), an $80M DoD-sponsored joint campaign model. AEA is drawing on its THUNDER and STORM experience to shape the space capabilities of JWARS. Correctly depicting space in JWARS is particularly important since it will be the model of choice for cross-service trade-off studies during Quadrennial Defense Reviews. HQ AFSPC senior leadership is determined to see that space systems and capabilities are treated fairly. As the Command's campaign analysis organization, HQ SWC/AEA will stay engaged in JWARS development to ensure just that.

SPACE ENVIRONMENT IMPACTS ON MILITARY OPERATIONS

Capt Filby, 55 SWXS/DOUT, DSN 560-6228

For the past decade, the space operations community has been lulled into complacency. The space environment has been rather benign; that will soon change.

The Sun has an eleven year cycle of activity, going from the 'calm' that operators enjoyed for the past few years to exceptionally active, which will arrive in less than a year. The peak of the solar cycle is called solar maximum.

Already the sun has shown hints of solar maximum. Over the past few months we have seen sunspot groups grow more plentiful and more magnetically complex; geomagnetic activity has reached levels not seen in nine years, and flare activity doubling and tripling previous rates.

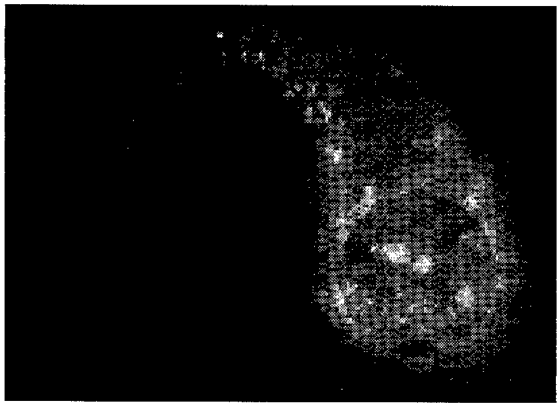
Why should the space community be concerned about activity occurring 93 million miles from earth? As the solar activity levels increase, DoD system impacts will likely increase. These impacts can include satellite damage, communications upsets, and disruption in operations.

We expect, at a minimum, communications disruptions during solar maximum. This is a period when satellite radio signals can fade and occasionally be completely attenuated. Due to irregularities in the Earth's ionosphere we can expect total loss of signals, data dropouts on satellite command uplinks and downlinks, and interference with ordinary satellite communications.

Solar-induced effects can, however, be more serious for satellite operations. Atmospheric drag increases during periods of geomagnetic storming. Low earth orbiting spacecraft will experience denser 'air' causing premature orbital decay, decreasing altitude and increasing orbital speed. The net result will be a difficulty in acquiring SATCOM links, increased orbit maintenance maneuvers, and unreliable de-orbit predictions. (Skylab fell victim to this last item during a large geomagnetic storm .)

Spacecraft charging events also increase during the solar maximum period. The sun discharges high-energy electrons and protons that can penetrate satellites. As they pass through, they can ionize (i.e. deposit a charge) components deep inside the satellite causing bit flips, spurious commands, data corruption, and physical damage to on board components.

Low energy electrons of solar origin also increase in the near Earth environment. Satellites surfaces are exposed to a greater number of electrons, becoming vulnerable to electrostatic discharge. This can cause degradation of electrical components and even failure or damage to thermal coatings, solar cells, and electrical components. It can also cause false sensor readings. In extreme cases, a satellite's operational life can be reduced, necessitating the unplanned launch of a replacement satellite.



The sun in x-rays showing low solar activity (solar minimum) on the left progressing to solar maximum conditions on the right.

Another side effect of the increased high-energy proton events during solar maximum is satellite disorientation. As the protons stream from the sun, they can impact a satellite sensor. The resulting bright flash produced can cause the satellite software to falsely interpret it as a star. When the computer software fails to find this "new" star in its star catalogue, or incorrectly identifies it, the satellite will lose attitude lock with respect to Earth. Directional communication antennae, sensors, and solar cell panels would then fail to see their intended targets. This can seriously impact satellite command and control, power budgets, and the primary mission.

Finally, in addition to the increase in solar particles, solar maximum produces an elevated radiation environment in which satellites operate. Microelectronics aboard spacecraft can be vulnerable, especially in "unhardened" systems. Manned spacecraft (and to some extent high-altitude aircraft) missions must take this environment into account as well when considering the maximum allowable radiation dosages for their crews.

The space environment is not benign. It can be quite hazardous to operations conducted in and through its boundaries.

SPACE INFORMATION DISTRIBUTED ARCHITECTURE (SPIDAR)

Maj Tom Smith, HQ SWC/DOOS, DSN 560-0421

Have you ever wanted to know how to get access to all that space information and tools that you know are out there, but didn't know an easy, inexpensive way to get it? That is what Space Information Distributed Architecture (SPIDAR) was intended to help out with. SPIDAR's goal is to explore, in a rapid prototype, research and development environment, web technologies and a network-centric approach to enhance the availability of space related information to any warfighter with a computer connected to the Secret Internet Protocol Routed Network (SIPRNET) and a web browser. This approach will provide reduced cost, reduced footprint of communications/computer equipment required, increased availability of space information/tools, improved responsiveness, and improved ease of use to end users of space information and space related tools whether in garrison or deployed.

SPIDAR is being developed under the Space Warfare Center's Tactical Exploitation of National Capabilities' (TENCAP) Talon Warrior program. It was endorsed by the TENCAP O-6 Review Group 28-29 Jan 98, and responds to MAJCOM articulated (via the Talon Warrior space training centers (STCs)), space and TENCAP requirements for space-based information and planning tools, ranging from academic space training material to complex space orbitology analysis and visualization tools.

Historically, space requirements have been satisfied by delivering prototype, stovepiped systems. The primary thrust of SPIDAR is to provide the warfighter with relevant space information and space applications via existing and emerging web-based architectures, thereby reducing his/her reliance on stovepiped systems, with their associated operations and maintenance costs.

Since one of the primary objectives of SPIDAR is to improve access to space information, the project first focused on using standard web technology to build a new space information home page. This home page has a general theme of Training and Education and includes theater focused space POC info, space training schedules and courseware, space related exercise and wargame info, and other operationally relevant space info (AFTTP 3-1, Aircrew Combat Information Guide, etc.) that is not otherwise electronically available.

Two areas of space applications, GPS Navigation Accuracy and Space Environment, are being developed in this web-based architecture to demonstrate the dynamics of distributed space support and enhance the currently provided capability. Exploratory development is also directed at integrating output from these models with a web-based orbit visualization tool to view space data in a combined, graphical display.

Today, to predict Global Positioning System (GPS) navigation accuracy, models use almanac data downloaded from the satellites, and can be 24 to 48 hours old when it is received. One of the models SPIDAR is incorporating will be able to incorporate more accurate and timely data directly from 2nd Space Operations Squadron. This model is expected to give a 70 to 80% increase in fidelity of the accuracy prediction. When approved for operational use, this tool could be used for mission planning to decide the optimal time for using GPS aided munitions to their best advantage.

For Space Environment, SPIDAR will incorporate two models using data directly from the 55th Space Weather Squadron. One model predicts the effect of space environment on UHF SATCOM, and the other predicts its effects on HF communications. Both models will be available in this web-based environment, and will have easy to interpret graphical outputs to enable planners around the world to easily access and understand the impacts.

Since SPIDAR is a TENCAP project, it uses a rapid prototyping methodology and uses a spiral development process. All development is focused on theater warfighters' space and TENCAP requirements. The most important aspect of SPIDAR's development process is user feedback. This feedback guides the development of the look and feel, and operation, of the current and future space tools.

Although SPIDAR primarily focuses on delivering space information and applications to Talon Warrior STCs via distributed architectures, of almost equal importance is SPIDAR's development and integration role supporting the Space Battle Manager (SBM) program. SPIDAR development efforts have been closely coordinated with AFSPC and USSPACE to ensure compatibility and eliminate duplication of effort between SBM, SPIDAR and other similar

development efforts. This provides a transition path for all of the operationally useful capabilities that are demonstrated in this rapid-prototype, concept exploration TENCAP environment into more traditional programs.

Currently, SPIDAR is in Phase II development, fleshing out the applications currently on-line, to incorporate user feedback and integrate the applications described above. The SPIDAR development team is working with ESC/ND and AFSPC/SCM to develop a combined initiative for JEFX 99 called Space Battle Management Core Systems (SBMCS). This initiative will incorporate the SPIDAR architecture and lessons learned from its development into a distributed space command and control system. SBMCS will be the operational follow-on to SBM.

SPIDAR is funded in its entirety by the Air Force TENCAP program and is managed by the Space Warfare Center's Space Integration Branch, SWC/DOO. The Space Applications Project Office (SAPO), SMC/ADA, provides the contract vehicle and manages execution/oversight of the deliverables as SWC's acquisition agent IAW the TENCAP Task Plan (TTP) for SPIDAR.

Contractor support for SWC R&D, including SPIDAR, is provided by a seven company team called Systems, Engineering, Demonstration and Integration (SEDI) including members from: Lockheed Martin Missiles & Space, Sanders, Lockheed Martin Tactical Aircraft Systems, Booz-Allen & Hamilton, General Research Corp Inc, ARINC, and Space Applications Corp.

With introduction of a prototype one stop shop for space data, customized data delivery, and enhanced space tools, this exploitation of web technologies reaches into many areas of mission support. The inclusion of space doctrine, guidelines, tactics and training documentation, as well as links to other space related sites, begins the road to increased space awareness. This awareness opens the door to out of the box concept development from the warfighter's perspective, that will enable the fluid, combined air/space campaign planning & execution envisioned within the near future.

SWC POC for SPIDAR is Maj Tommy Smith, SWC/DOOS, DSN 560-0421, or commercial 719-567-0421. SAPO POC is Capt Charles Fredrick, DSN 560-4044, or commercial 719-567-4044.

To connect to the current version of SPIDAR, log on to SIPRNET and point your browser to spidar.swc.spacecom.smil.mil, or point your browser to the operational Space Battle Management page at tsocserver.usspace.spacecom.smil.mil:443 and click on the link to Space Information Research and Development.

SPACE RESIDENCE EXPERTISE

TSgt Rik Meyers, HQ SWC/DOYX, DSN 560-9664

In a speech before the Fletcher School/Institute for foreign Policy Analysis, U.S Senator Bob Smith (R-NH) stated "...to achieve true dominance we must combine expansive thinking with a sustained and substantial commitment of resources, and vest them in a dedicated, politically powerful, independent advocate for spacepower." Instead of individuals at various levels of command independently working space issues, the Air Force must build space staffs and focus the effort within every Combatant Command subordinate to the unified commands. Each NAF staff should consist of at least two Weapon School/Space Division graduates, or equivalent, and several NCOs with theater specific training.

According to a Weapons School briefing given at the AFSPC Tactics conference, the Space Officer is the theater's focal point for planning, instruction and requirements. The space officer must also be the space integrator for OPLANS, purveyors of AFTTP 3-1 Volume 28, and the exercise space support coordinator. When the NAF transitions to a wartime mode the space officer becomes the weapons and tactics officer for the Joint Air Operations Center (JAOC) or the Air Expeditionary Wing (AEW) planning cell. The space officer also is the resident expert in Theater Missile Defense, communications and space weather environment. In addition, they must integrate space and air operations. The space officer must also facilitate space applications into communications, weather, and work with the

collection manager to gather space Intel. Currently, only one or two captains attempt to accomplish all this 24 hours a day/365 days a year.

How can they fulfill all the requirements expected of them? They can't! Space officers often request augmentee support during increased tension levels, crisis and exercises. A resident space staff would immediately increase the space presence and help the sole space officer perform the day to day taskings. The in-place theater space team can direct the actions of the space augmentees, or even remove the need for them.

The space staff should be comprised of at least two Weapon School/Space Division graduates, or equivalent, a space NCO (1C670) and an Intel NCO (1NX71) who have graduated from the same type of school (such as the JAC2C at Hurlburt Field). The NCOs must be E-7/E-6s with at least 8 years working in their career field. In addition to the JAC2C, the Intel NCO must have graduated from a targeting school and have previous space experience. The space NCO needs to have a strong background in satellite operations and theater missile warning. The Intel NCO can specifically work with the A2 section and the collection manager to incorporate space Intel into the collection management plan.

Senator Smith sums it up best in his speech at the Fletcher School/Institute by stating, "We must create an environment in which revolutionary thinking about spacepower is not only accepted, but rewarded." He went on to state, "The emergence of a real spacepower force will require the creation of a highly skilled, dedicated cadre of space warriors clearly focused on spacepower applications—not merely on helping air, sea and ground units to do their jobs better."

SATELLITE TRACKING USING AMBIENT RF (STAR)

Maj Wayne Rezzonico, HQ SB/SBB, DSN 560-8471

The Space Battlelab stood up at the direction of the CSAF on 30 Jun 97. Our mission is to identify innovative space operations and logistics concepts and rapidly measure their potential for advancing the Air Force Core Competencies and Joint Warfighting. During the past 18 months, the battlelab developed, received funding and executed 11 innovations. These concepts range from better satellite tracking to new approaches for getting real-time information into the cockpit.

Four of the battlelab's current initiatives support the Space Surveillance Network (SSN). The mission of the SSN is to detect, track and identify earth-orbiting objects providing vital situational awareness of blue, grey and red space capabilities.

The SSN Optical Augmentation (SOA) demonstrated the ability of small aperture commercial-off-the-shelf (COTS) telescopes costing approximately \$1M. Three telescopes augment the \$30M Ground Based Electro-Optical Deep Space Surveillance System (GEODDS) for tracking deep space objects. Deep space is defined as those objects with orbital periods in excess of 225 minutes. A second SSN initiative called Space Object Identification (SOI) in Living Color (SILC) looks at the ability of GEODDS to fingerprint deep space objects by using multi-color photometry. The battlelab is also investigating ways to mitigate the effects of atmospheric drag on low earth orbiting objects under the Modified Atmospheric Density Model (MADM) initiative. Look for more information on these projects in upcoming articles.

One final SSN initiative underway is entitled Satellite Tracking Using Ambient RF or STAR. This project demonstrates the ability to detect, track and identify objects in near earth orbits using energy from TV transmitters. In concept, the idea is very similar to conventional radars. Both use the techniques of Time Difference of Arrival (TDOA) and Frequency Difference of Arrival (FDOA) to compute the range and velocity of an object of interest. The unique twist on the battlelab efforts was the unique ability to exploit non-cooperative transmitters as a source of energy, for example, TV transmitters.

The current SSN is not as robust as the space surveillance community would like. In general, debris may go uncataloged for long periods, satellite maneuvers are not rapidly detected, and new launches take time to assess. Four factors contribute to this shortfall: cost, capacity, coverage, and capability.

Conventional radars used for near earth space surveillance are very expensive systems costing $200-$500M a copy. With today's budget realities, the likelihood of fielding new sensors is remote. Conventional radars expend great amounts of energy to illuminate targets of interest. As a result, there is a significant cost associated with operating these systems. In addition, the radars are based on 1970's technology. Spare parts are not readily available, driving up O&M costs.

Since 1980, the number of objects in near earth orbit has risen by 50%. Furthermore, the Peace Dividend sparked by the end of the Cold War reduced the availability of funding to sustain the SSN. Over the last eight years, we closed four sensors. This divergence will lead to capacity problems in the future.

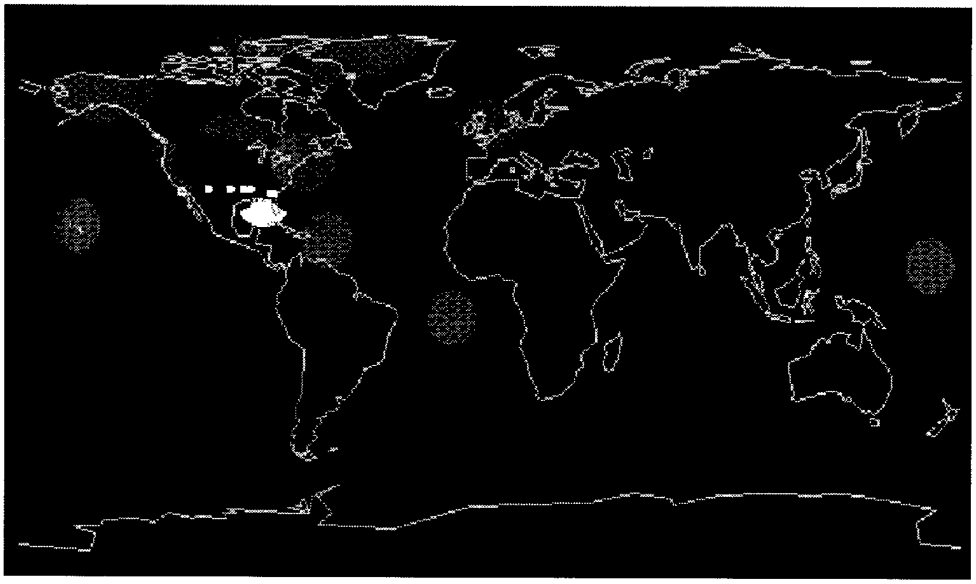


Figure 1. *SSN Coverage for 100km Altitude Satellite*

Another problem with the current SSN is coverage. Figure 1 shows the existing coverage for a typical satellite at 1000 km. The colored areas denote the volume of space that a satellite is within the field of view of a sensor. Due to the large number of missile warning radars surrounding CONUS (which function as collateral sensors) the coverage is very good. However, there are few sensors in the Southern Hemisphere, and over Europe and Asia. These gaps lead us to the capability issue.

Today, the SSN is predictive in nature. The SSN takes observations of a satellite at a particular time, then by using the laws of orbital mechanics we project the satellite's location in the future. We can only detect a satellite has maneuvered when it does not show up in the future when and where we expected it. This has grave consequences for deployed troops when the adversary is capable of overhead intelligence gathering.

These issues led the battlelab to apply existing bistatic technology to this problem. The STAR demonstration was designed to demonstrate how a passive, phased array antenna could provide a cost-effective augmentation to the existing SSN. The demonstration set out to answer several critical questions.

What size object can I see? As it turns out, that is only half the question. Small objects can be seen at close ranges, larger objects at significantly greater ranges. The STAR demonstration was able to reliably detect a 1 m2 satellite at a range of 500 km, and a 10 m2 satellite at a range of 1000 km. When these numbers are applied to the Space Order of Battle, approximately 94% can be tracked at least once daily with a passive array the size of two football fields (100 m by 100 m).

How accurate is the system? The system works by exploiting multiple TV transmitters simultaneously. This provides measurements from several aspect angles concurrently. This vast amount of data allows the system to triangulate the satellites position to 100 m under the proper conditions. By comparison, current SSN radars are accurate to

300-1500 m. This accuracy allows for the correlation of observation to known objects which can be used to support satellite catalog maintenance.

What does it cost? Preliminary estimates based upon the STAR demonstration suggest a system could be fielded for approximately $10 M. This is an order of magnitude reduction over conventional sensors. Since this is a passive, unmanned sensor, operating costs are expected to be a very small percentage of conventional sensors.

While the STAR concept proves to be a viable technology, it is not as capable as current radars. For example, STAR is not able to detect and track small debris critical to protect the International Space Station. In addition, its field of view is limited to approximately 30 to 90 degrees in elevation vice 3 to 85 degrees for a conventional phased array. However, its low costs make it an attractive alternative to conventional sensors and is being evaluated by HQ AFSPC to determine how it can best be used to support SSN operations.

If you have an innovative or revolutionary space concept for the SB to demonstrate, or are just looking for additional information on SB initiatives, please contact us through the following points of contacts.

Mailing Address
AF Space Battlelab
730 Irwin Ave, Ste 83
Schriever AFB, CO 80912-7383

Web Address
www.schriever.af.mil/battlelab/

Telephone
DSN 560-9392
(719) 567-9392

E-Mail Address
spcbtlab@swc.schriever.af.mil

FAX
DSN 560-9937
(719) 567-9937

WHY AND HOW WE TEST ICBMs PART II

Maj Mark A. Meyer, 576 FLTS/TEE, DSN 275-6316

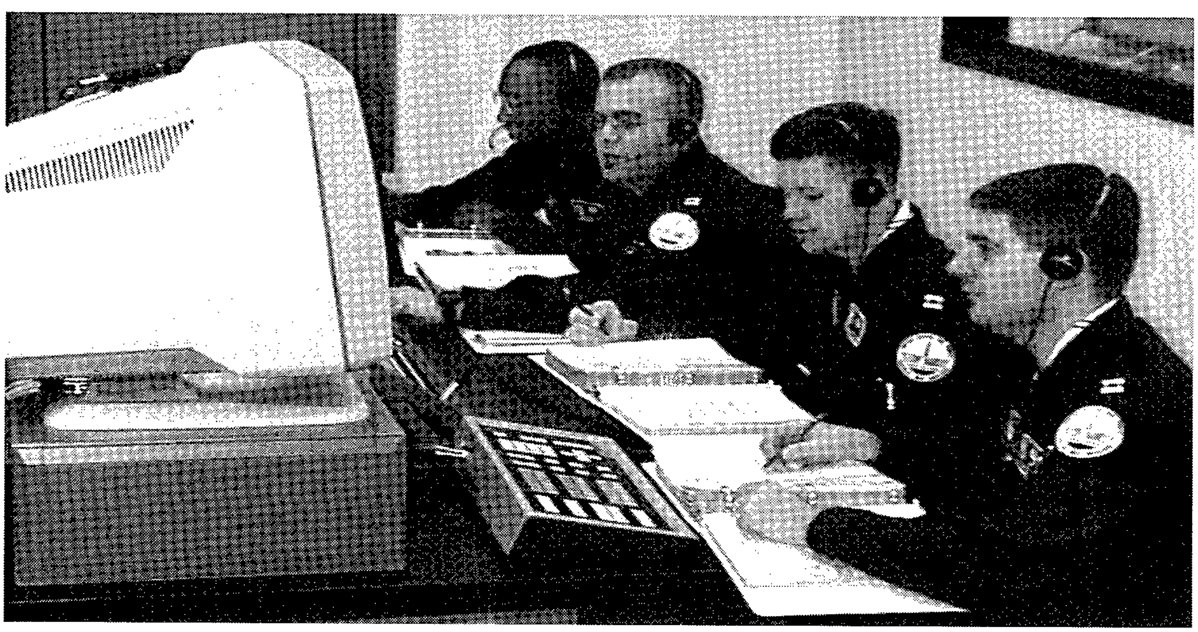
As a follow-up to the article written by HQ SWC/XRTM, MSgt Welton, in the Winter 97/98 volume of the Space Tactics Bulletin, this article completes the picture by exploring the operations side of our extremely successful testing program.

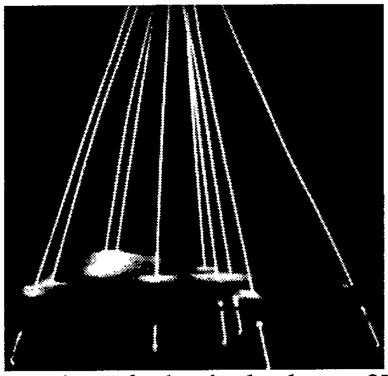
I. TOP HAND

Since 1972, Space and Missile operators of the selectively manned TOP HAND program in the 576th Flight Test Squadron (FLTS) have planned, coordinated and trained to meet or exceed every objective of our nation's ICBM test program. The 576 FLTS is the sole unit responsible for flight testing AFSPC's only offensive weapon systems, the Minuteman III and Peacekeeper ICBMs. Months, and in some cases, years before the missile launches, thousands of hours of meticulous preparation go into each mission. TOP HAND test operations directors develop detailed countdown procedures that set the standard for Western Range launch operations. The USAF's best and brightest weapon system experts put in long hours to plan for every contingency.

Operational realism is an important part of our Force Development Evaluation program. However, safety is absolutely paramount. The direction and guidance of the entire countdown team ensures the Task Force from the operational unit knows all the requirements to properly configure the sortie for a safe mission. The countdown team, made up entirely of "blue suiters" from the 576 FLTS, perform numerous pre-launch procedures to ensure telemetry, tracking and range safety systems are all fully operational.

The TOP HAND Test Manager (TM) is responsible for ensuring every Western Range support detail, from radar coverage to telemetry sensors, is perfect. The TOP HAND Launch Director (LD) is in charge of executing every aspect of the detailed countdown procedures. Based on recommendations from the LD and TM, the Mission Director (576 FLTS/CC) makes a final Go/No-Go decision with the 30th Space Wing Commander, who grants us permission to enter terminal countdown. If all systems are "GO," the Western Range gives us a "Green" and the TOP HAND countdown team directs the Task Force missile combat crews to turn keys, initiating the final launch commands to the sortie. Within seconds the missile is in flight towards the Kwajalein Missile Range 4,200 nautical miles into the Pacific Ocean.





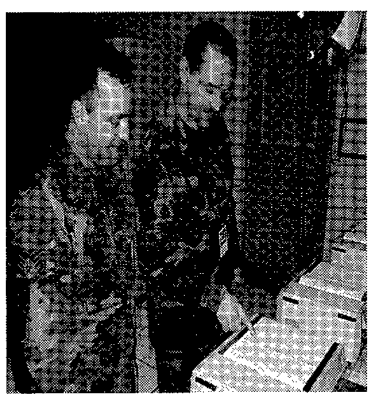
II. Launch Analysis Group (LAG)

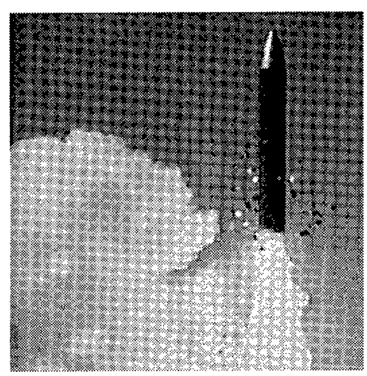
As soon as the reentry vehicles impact the Kwajalein Missile Range, usually in the wee hours of the morning, the next major test responsibility begins. Without the performance report, our operational test launches would be nothing more than an impressive light show. Systems Engineering analysts are charged with troubleshooting anomalies, compiling weapon system scoring and documenting nearly every aspect of the launch vehicle's performance.

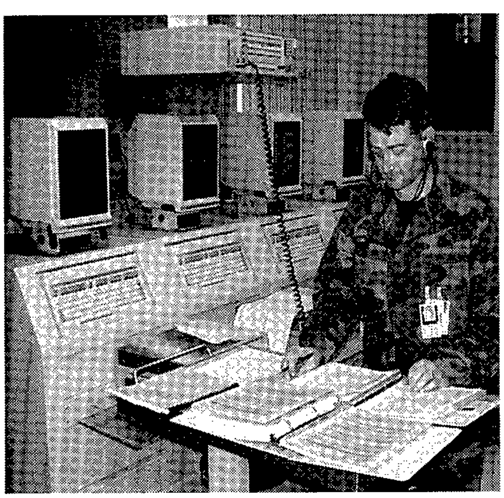
Systems Engineering, also known as the Launch Analysis Group (LAG) consists of selectively chosen 2MOX1 and 2E8X1 personnel. LAG members are all hand-picked based on their telemetry and weapon system knowledge. These blue suited superstars truly are the acknowledged "Rocket Scientists" of the ICBM test community.

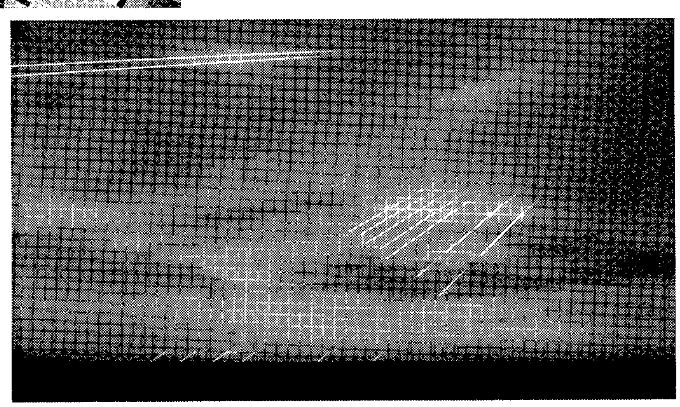
LAG technicians analyze information and compile detailed performance reports based on the telemetry, metric and optical data obtained from each mission. Strategic planners use data from these reports to help develop the Single Integrated Operational Plan (SIOP). LAG members really earn their reputation as technical wizards when we experience an anomaly. In this situation, they reconstruct the data in an effort to find out what went wrong and determine the root cause.

The LAG and TOP HAND members are not just cold war warriors testing ICBMs. Today, nearly every mission has at least one internationally significant associated operation. For example, a recent launch included a Slender Hypervelocity Aerothermodynamic Research Probe-Ballistic (SHARP) reentry vehicle. Critical data is collected from tests like the SHARP experiment, which will be used on the space shuttle and other AeroSpace programs. The National Missile Defense program has also been a very active participant on our launches. ICBM testing is a vital program, which has numerous agencies and hundreds of personnel nel supporting our primary focus--DEMONSTRATING DETERRENCE!









AIRCREW RESCUE – TACTICAL EXPLOITATION OF NATIONAL CAPABILITIES (TENCAP) STYLE
PROJECT HAVE COMBAT SEARCH AND RESCUE (CSAR)

Major Kevin Murphy, SWC/CTK, DSN 560-8767

A downed aircrew member is trapped behind enemy lines and needs to be rescued as soon as possible. How does he let his rescuers know exactly where he is and what his physical condition is without the enemy finding out? AF Tactical Exploitation of National Capabilities (TENCAP) Talon Knight project, HAVE Combat Search and Rescue (CSAR), is an architecture that solves this problem.

HAVE CSAR ARCHITECTURE

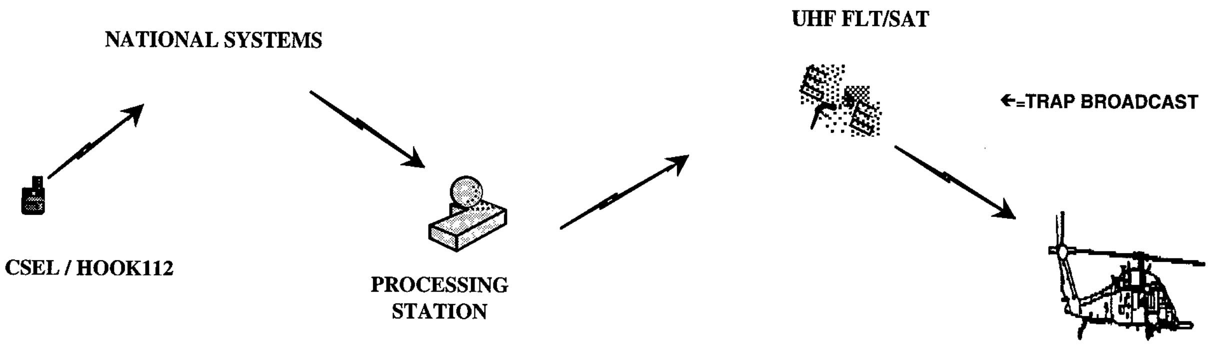


Figure 1 – *HAVE CSAR Architecture*

Using HAVE CSAR, the aircrew can use either HOOK-112 or the the Combat Survivor and Evader Locator (CSEL) radio to transmit positional data over the horizon via National systems to the rescuers. The data is received via a tactical radio installed in an HH-60G rescue helicopter enabling the helicopter to receive National and tactical data directly into the cockpit. This informatione data is routed from the tactical radio to the pilot's display unit. (See Figure 2)

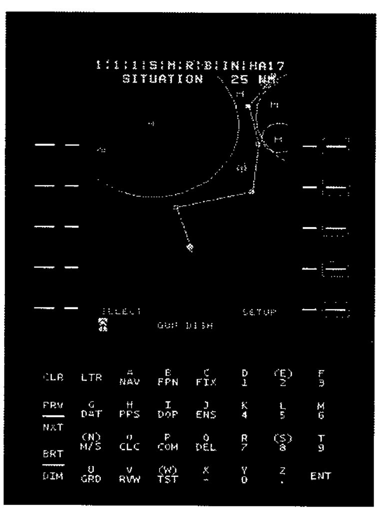


Figure 2 – ***Aircraft & Threat Ring Display***

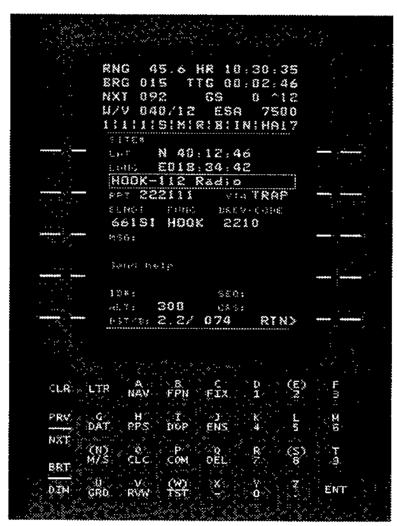


Figure 3 – ***Survivor Position Display***

The displayed data includes the aircrew's position and status as well as threat information for situational awareness. (See Figure 3) Threat rings are displayed for threats in the area so the pilot will know when he is in harm's way.

The pilot also has an option to select the survivor's CSEL reported position as a navigation "way point" and have it reflected in his flight route displayed in the cockpit. Through HAVE CSAR, the rescue helicopter will be able to fly directly to the downed crewman while minimizing exposure to known enemy threats.

The helicopter community is interested in using HAVE CSAR to solve their requirement to receive CSEL data over-the-horizon. Since the current size and weight of the tactical radio are excessive for helicopters, the Talon Knight team will look at building a streamlined single channel tactical receiver, "Concord," in FY99. In the meantime, the HAVE CSAR architecture will be implemented as shown in figure 1.

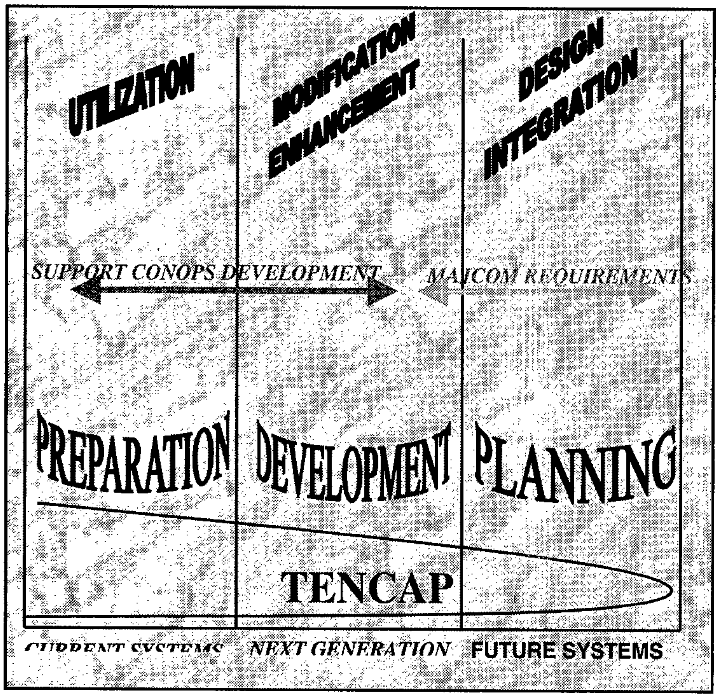
DESIGNING TOMORROW'S VICTORIES
AF TENCAP INFLUENCING FUTURE SPACE SYSTEMS

Capt Chuck Chamber, HQ AFSPC/Talon Vision, DSN 560-9012

Have you ever wondered how the Air Force acquires new space systems? Do you have an idea that you wished the Air Force would consider in their next generation space systems? There is a division within the Space Warfare Center who provides input to the Air Force space architects and space system designers. This group is under the AF TENCAP division and goes by the name of Talon Vision. Their primary focus is to ensure warfighter tactical requirements are integrated into the Air Force's requirement process for the 2010 to 2025 timeframe. Talon Vision has existed for three years; however, during this time, they have been very effective in ensuring tactical requirements are integrated into future space intelligence, surveillance and reconnaissance (ISR) systems. Training requirements that are often overlooked have been stressed and added to the next generation signals intelligence (SIGINT) systems. Additionally, Talon Vision was able to ensure those tactical requirements most important to the MAJCOMs were enforced during the recent imagery intelligence (IMINT) system requirements review and justification.

This fiscal year, Talon Vision is venturing into new territory. The Air Staff tasked Talon Vision to generate an Intelligence Needs Document (IND) for the MAJCOMs to document their ISR requirements for the 2010 and beyond timeframe. The Talon Vision team is developing a future requirements baseline which can be used by all space system developers. This IND is not tied to a specific weapons system and employs the strategy-to-task-to-need-to-specification framework. In this manner, a developer will be able to understand why the operational community requested an individual specification.

The chart below shows where the AF TENCAP program can best influence both new space systems and new concepts of operations. The Air Force must shift their current thinking in order to ensure future space systems meet their 2010-2025 support needs. We must identify our tactical missions and requirements needs now in order to effectively prepare for our future integrated AeroSpace environment. That means we cannot wait for the space systems to get off the drawing boards and become operational before we figure out how to use them to support our missions.



The next task for these path forgers is to develop processes to integrate warfighter needs into future commercial and civil space systems.

If you want to know more about influencing future space systems, please feel free to contact the Talon Vision team at DSN 560-9326.

THE SPACE WARFARE CENTER'S AEROSPACE FUSION CENTER

Lt Col Leland Horn, HQ SWC/XRV, DSN 560-9824,
Capt Dave Fewster, HQ SWC/XRM, DSN 560-9431,
Mr Howard Zach, HQ SWC/XRVA, DNS 560-9316

Executive summary:

The *AeroSpace Fusion Center* (AFC) was originally chartered as the Strategic Defense Initiative Organization (SDIO) program TALON SHIELD. With the activation of ALERT as the operational result of TALON SHIELD developments, the program was renamed SHIELD. SHIELD funding and advocacy slowly transferred from the Ballistic Missile Defense Organization (BMDO) to Air Force Space Command (AFSPC). The impending shutdown of ALERT and misperceptions about SHIELD prompted the Space Warfare Center to rename the program the *AeroSpace Fusion Center.* This title aims to highlight proven AFC advances in the realm of multi-source, diverse sensor, cross cueing and data fusion that greatly enhances current and future system capabilities.

Through many years of empirical data collection and processing, the *AeroSpace Fusion Center* has demonstrated that no single sensor, nor any single sensor band can provide all the necessary data to accurately characterize a theater or national class missile with enough accuracy to counter the threat with existing weapon systems. That being the case for the present and foreseeable future, a strategy of sensor cueing, sensor data fusion, battlespace characterization, and technology exploitation is critical to meet warfighter needs. Whether considered "gapfillers," "risk reduction," or "technological enhancements," the *AeroSpace Data Fusion Center* has proven capabilities that can rapidly and inexpensively be brought on line to support warfighter missions.

By its very nature, sensor data fusion does not conveniently fit within any current acquisition program. The AFC is not just space, but utilizes air and ground assets in concert with space to solve warfighter problems. The AFC

conducts operations jointly, working with the Army, Navy and National communities to solve problems. The need for data fusion is well documented in a variety of requirements documents up to the Joint Chiefs of Staff level. Unfortunately, no one program, organization or command, has solely funded these efforts because this simple process does not benefit any one program, but rather provides a single, beneficial product to the warrior.

Ideally, the AFC could be a separate program element chartered to deliver near-term, cost-effective solutions to the Theater and National Missile Defense Communities to benefit all theaters. Without a focused program management approach, our nation risks losing the ability to quickly, efficiently and effectively improve the protection of the United States and deployed forces, worldwide.

Vision:

Support warfighting operations with "the cutting-edge" in information superiority and management through our core competencies of AeroSpace Data Fusion, Battlespace Characterization, and AeroSpace Technology Exploitation. With clearly mapped projects supporting warfighter missions, the Center continues to design, develop, demonstrate, and deliver systems and capabilities *for the warfighter*, with an emphasis on network-centric operations, interoperability, and joint combat power.

History:

Guided by lessons learned during Desert Storm and funded by the [then] Strategic Defense Initiative Organization, Air Force TENCAP's TALON SHIELD program focused on rapid system prototyping to enhance theater missile warning. Since its inception in 1992, the program leveraged advances in computational technology and developed new techniques in DSP satellite and multi-source data fusion. The capabilities developed resulted in order-of-magnitude improvements in theater missile reporting timeliness and accuracy.

On March 10, 1995, TALON SHIELD declared its first major victory when Phase I of the program reached operational maturity in less than 32 months and with a total investment of only $43 Million. Designated ALERT (Attack and Launch, Early Reporting to Theater) and manned by a newly established 11th Space Warning Squadron, TALON SHIELD Phase I transitioned to the premier world-wide theater missile warning capability, and serves in that capacity to this day.

Realizing its potential for applying new technology to other mission areas, the Office of the Secretary of Defense and the Ballistic Missile Defense Organization directed TALON SHIELD (under the new designation "SHIELD") to continue research, development, demonstration, and delivery of capabilities and systems pertinent to this mission area. Since 1995, SHIELD has not only served as the prototyping and testing system for enhancements to ALERT; it has also demonstrated support to mission areas other than missile warning. SHIELD recently demonstrated new systems that greatly enhance passive defense, active defense, attack operations, time critical targeting, national missile defense, battlespace characterization, and other classified programs.

The newly renamed *AeroSpace Fusion Center* (AFC) now has the potential to stand at the forefront of providing near-term solutions to ongoing warfighting problems. The AFC can provide 21st century military operations many of the tools needed to control the battlefield.

Ongoing successes:

National and Navy Theater-Wide Missile Defense: The *AeroSpace Fusion Center* has routinely demonstrated advanced National Missile Defense (NMD) technologies during domestic missile launches since 1993. The bulk of the funding for this effort has come from the Navy Theater-Wide program to exploit targets of opportunity. The Fusion Center provided space-based launch detection, cueing to early warning and narrow-beam X-band radars and fusion of all these data sources. This fused data was converted to In Flight Target Updates to the captive-carry seeker success-

conductsfully resulting in on-target pointing for every event.

This system has demonstrated substantial improvements in the following:

- In-flight position in support of active defense radars, thus increasing their effective threat detection range, probability of detection and engagement envelope.
- Impact point determination in support of passive defense to minimize unnecessary warning and its adverse impact on operations tempo.
- This in turn provides commanders and troops under fire greater flexibility and effectiveness in responding to the threat.

Enhanced Early Warning: The Enhanced Early Warning (E2W) system fuses missile data from Defense Support Program (DSP) satellites and in-theater, tactical radar systems. This system demonstrated dramatic improvements in missile tracking performance during the Navy's Autumn Tracking Events. Additionally, E2W was a key player in the recent Sensor Netting Demonstration (Nordic Thrust) where diverse sensors were used to track SCUD TELs from pre-launch through post-launch evasion. E2W was the only Air Force initiative approved under the IMPACT 98 Congressional bill for rapid theater missile defense support to South West Asia. E2W has an initial development cost of $6.0 million and a preliminary deployment to theater scheduled for August 1999.

This system has demonstrated vast improvements in the following:

- Missile launch point determination to support attack operations and combat identification.
- In-flight position in support of active defense radars, thus increasing their effective threat detection range, probability of detection and engagement envelope.
- Impact point determination in support of passive defense to minimize unnecessary warning and its impact on operations tempo.
- Provides commanders and troops under fire greater flexibility and effectiveness in responding to the threat.

The Integrated Surveillance System is an analogous capability for the Korean theater, but is currently unfunded.

Theater Airborne Warning System: The Theater Airborne Warning System (TAWS) is comprised of a mid-wave infrared array (MIRA) of sensors onboard the Cobra Ball aircraft, and the processing technology to fuse these data with data collected by DSP satellites. The MIRA has a higher scanning rate than DSP, and also operates in a different infrared band. TAWS has proven to operate effectively with both the CONUS based *AeroSpace Fusion Center* and the Joint Tactical Ground Station. Additionally, when combined with the E2W system, the whole becomes greater than the sum of the parts. Airborne mobility enhances the system's responsiveness to emerging threats worldwide.

This system has demonstrated improvements in the following:

- Missile launch point determination to support attack operations and combat identification.
- In-flight position in support of active defense radars, thus increasing their effective threat detection range, probability of detection and engagement envelope.
- Impact point determination in support of passive defense to minimize unnecessary warning and its impact on operations tempo.
- Provides commanders and troops under fire greater flexibility and effectiveness in responding to the threat.

TAWS is proposed for fleet-wide deployment on Rivet Joint to provide robust support to deployed forces.

Theater Situational Analyst Workstation: The Theater Situational Analyst (TSA) Workstation was originally designed as an intelligence aid for the 11th Space Warning Squadron. To assist operations crews in assessing the validity of a missile launch, the TSA receives and aggregates a variety of classified and unclassified intelligence, weather, terrain, and imagery information together on a single display. This system has greatly enhanced the situational awareness of ALERT Space Warning operators and can do the same for deployed forces.

Hotwalker and Launch Support: The *AeroSpace Fusion Center* has monitored all major and/or controversial space launches since late 1997, and has been able to provide independent verification of successful or failed events.

In the case of Hotwalkers, the *AeroSpace Fusion Center* has performed extensive real-time operations monitoring live events and has demonstrated that the capability, if implemented operationally, would provide ORDERS OF MAGNITUDE more accurate information to the National Command Authority, military and civilian organizations than is currently available. Costs associated with fine tuning and operationalizing this capability are minimal considering the national and international impacts and ramifications these events may create.

Exercise Support: The AFC also supports several interactive simulation for the BMDO Theater Missile Defense System Exerciser. This system is mandated for use by the TMD Major Defense Acquisition Programs to demonstrate their interoperability. This same system is used to support major computer aided exercises such as Roving Sands and Optic Windmill.

Pathfinders for the Future:

To chart the course toward 21st century warfare, the *AeroSpace Fusion Center* has established mission enhancement roadmaps detailing seven specific projects that are logical extensions of current fusion center initiatives. The co-development of these projects is guided by an integrated master plan. This approach enables network-centric operations, interoperability, and joint combat power while minimizing stove-piped development and duplication of effort. The end result of these projects will be further substantial improvements in warfighter capabilities. For most of the projects below detail has been omitted to keep this paper unclassified.

Multi-Data Fusion: This project expands on the current E2W and TAWS data fusion capabilities to incorporate real time fusion of additional operational sensors to support the theater warfighter. This will optimize threat information support to the warfighter by providing direct theater support with a mobile fusion concept incorporating multidiscipline fusion. This project can be expanded to include National Missile Defense with only minor changes.

Dynamic Battle Management Display Tools: This project provides the foundation to support a variety of TMD processes as this infant area of military operations matures over the next four to five years. The Theater Situation Analyst Workstation (TSA WS) developed for ALERT is the point of departure for these efforts. In the near term we will focus on developing an improved system for theater users incorporating more data sources for enhanced battle management and situational awareness. In the long term we will develop relationships with strategic users, such as the Space Based InfraRed System (SBIRS), to tailor this system to support their BSC requirements. This system will offer substantial improvements by providing a single system capable of coherently displaying all relevant TMD information.

Air-Space Sensor Integration: This project's objective is to integrate the SHIELD fusion engine onto airborne platforms. The purpose is to allow for onboard and ground based fusion of data and cueing of the aircraft's organic sensors. The goal is to improve the theater warning system by increasing the number of data sources operating with fused data and networking these sensors into a system of systems where each supports the other. This project can be expanded to include National Missile Defense with only minor changes.

Tactical Parameter Estimation Enhancements: The objective of this project is to develop a robust, accurate profile-free parameter estimator initially for SHIELD R&D purposes, with the ultimate objective of transitioning the capability to SBIRS and any other profile dependent systems. Since the early days of missile warning, technology has limited our ability to provide highly accurate information on threat missiles without a profile-based template. As such, if a missile does not perform as expected, the resulting parametric information passed to warfighters could do more harm than good.

Advanced Data Fusion Center/Brass-E Fusion Pathfinder: This project is to expand SHIELD's capabilities by obtaining and fusing new National sources. To do so, SHIELD will conduct feasibility studies to guide algorithm development and determine utility of fusing BRASS-E, BRASS-F, Airborne Systems, and SBIRS. These additional data sources will be incorporated into the AFCs technologies. If operationally useful the data source will be migrated to the appropriate deployed systems. In any event, the data collected will aid in the development of follow-on systems.

Launch and Hotwalker Support: This project will attempt to utilize SHIELD's data fusion capabilities to provide realtime launch and hotwalker support. The means to achieve the objective are to establish a team within SHIELD to support live launch and hotwalker events, establish a customer base with requirements for this support, and continue research and development into data sources and tools to enhance this support.

Conclusions and Recommendations:

The *AFC* executes projects through the core competencies of AeroSpace Data Fusion, Battlespace Characterization, and AeroSpace Technology Exploitation, and supports the larger constructs of information superiority and network-centric warfare. Specific missions supported by the *AFC* include but are not limited to Theater and National Missile Defense, Attack Operations, Active Defense, Passive Defense, and Time Critical Targeting.

Initiatives started under our strategic roadmap ensure the co-evolution of the AFC with the evolving threat and warfighter requirements. Many of these initiatives are highlighted in JTAMDO's top 15 (with 3 of the top 4) recommendations to the JCS for immediate consideration.

The *AFC's* very nature demands working with diverse disciplines, systems, customers, and organizations. This paradigm shift toward cooperative, joint network-centric warfare makes it difficult to uniquely categorize the *AFC* let alone secure consistent advocacy or funding. Ideally, the AFC could be a separate program element chartered to deliver near-term, cost-effective solutions to the Theater and National Missile Defense Communities to benefit all theaters. Without a focused program management approach, our nation risks losing the ability quickly, we must efficiently and effectively improve the protection of the United States and deployed forces, worldwide.

SPACE SUPPORT TO SPECIAL OPERATIONS IN OPERATION JOINT ENDEAVOR/JOINT GUARD

Maj Allen W. Kirkham, HQ AFSOC/DOXS, DSN 579-3299
(Original Article Written January 1997)
Photos by Maj Kirkham while assigned to JSOTF2/J3, in Italy and Bosnia

We've all heard the saying, "Right place at the right time." That was certainly the case for me in September and October 1996. I am the Chief of Space Field Operations at HQ Air Force Special Operations Command, Hurlburt Field, Florida. Even though my primary job is to provide space expertise, in September 1996 it was my turn to pull my weight on the special operations staff and deploy to San Vito dei Normanni Air Station, Italy, Joint Special Operations Task Force 2 (JSOTF2), as Chief of the Joint Operations Center and action officer in the Operations shop. I found myself helping to plan and schedule air sorties in support of Operation JOINT ENDEAVOR. The timing couldn't have been better. Being the only Space Operations Officer on the deployed staff, I was unanimously elected as project officer to integrate the AFSOC Air Force Space Support Team (AFSST) into JSOTF2 air operations.

AFSOC AFSST in the JOC, JSOTF2, Operation JOINT ENDEAVOR

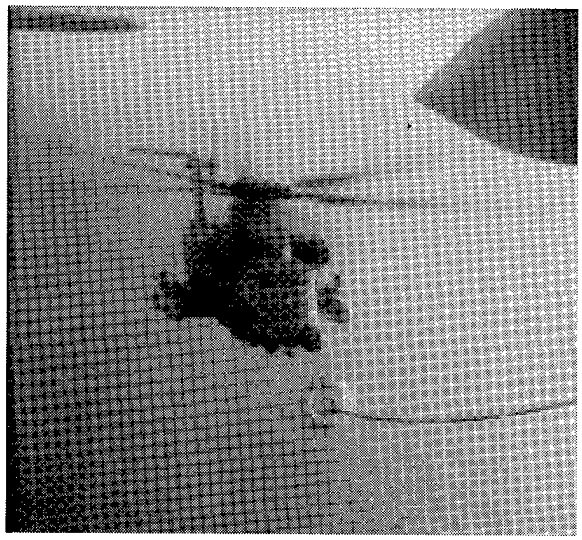
The 76 Space Operations Squadron AFSOC AFSST deployed to San Vito, Italy 25 Sep 96, at the request of the JSOTF2 Commander, in support of Operation JOINT ENDEAVOR in the Bosnia AOR. The team mission was to deliver space force enhancement to the Special Operations Command Implementation Force (SOC IFOR), specifically to support JSOTF2 Combat Search and Rescue and other special operations missions for 30 days to determine whether there was utility in providing space support to a deployed special operations flying unit. From day one, the AFSST established a good working rapport with the aircrews, squadron planners, intelligence, weather, communications, and special tactics team combat controllers and pararescuemen.

JSOTF2 flies AC-130U Spooky gunships, MH-53J PAVE LOW helicopters, and MC-130P Combat Shadow aircraft across the Adriatic Sea into Bosnia-Herzegovina and Croatia. Each platform has a unique mission and specific space support needs. The AC-130U Spooky gunship flies on-call Close Air Support (CAS) and route reconnaissance missions over Bosnia using optical, infrared, and radar sensors to cue its 25-millimeter Gattling gun, 40mm Bofors cannon, and 105mm Howitzer cannon, the biggest airborne gun in the world. "PAVE" crews perform CSAR, personnel recovery, and other special operations in the AOR, to include infiltration and exfiltration of USAF special tactics teams, Army Special Forces, or Navy SEAL (Sea, Air, and Land) teams in denied territory. The MC-130P Combat Shadow is the refueling platform for the PAVE LOWs and is used for special operations forces infiltration by airdrop or airland. These aircraft typically fly low level at night, under blacked-out conditions, to enhance survivability. The aircrews usually fly with night vision goggles (NVG) and terrain-following/terrain-avoidance equipment, even in bad weather to avoid detection by threats. These aircrews require computer fly-through previews and imagery/mapping data of ingress and egress routes, and obscure landing zones or drop zones. They eagerly welcome any space-based products that will ensure mission success and enhance their survival.

MH-53J PAVELOW of the 21st Special Operations Squadron takes off from "HLZ Pond"

The AFSST spent the first few days loading Bosnia AOR map, charts, and imagery into the Theater Support Operations Cell (TSOC) and Multi-Source Tactical System (MSTS) terminal, to tailor space-based products to specific mission and aircraft requirements. TSOC is a hardware and software suite developed by USSPACECOM for deployment teams to provide user friendly information on blue space systems, to include satellite footprints and schedules (i.e., when I can get optimum coverage for a given space system). MSTS provides near-real-time air and ground threat updates along the planned flight route and in the mission objective area.

The first week, the team conducted interviews and capability orientations with all the squadron mission planners and support staff to determine specific mission needs. After the initial set-up, they quickly became a daily routine part of our mission planning process. Our aircrews were very pleased with the custom made approach fly-throughs and full color printouts of Bosnian and Croatian airfields and helicopter landing zones. The team also provided target imagery to the Spooky gunship crews, weather packages to our forecasters, and near-real-time ELINT data to the A2 Intel shop.



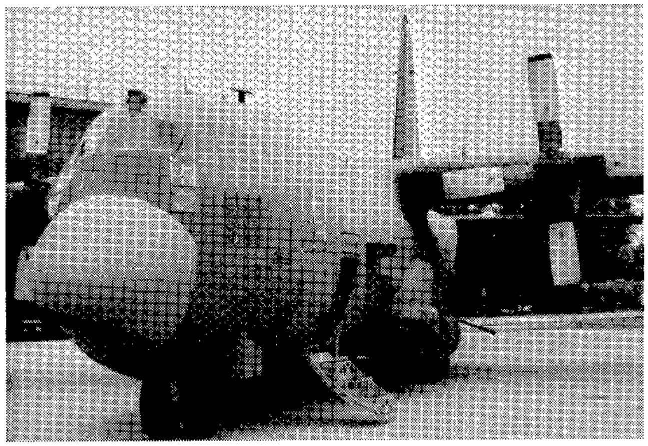
MH-53J PAVE LOW refuels from an MC-130P Combat Shadow over the Adriatic Sea

We were particularly pleased to be part of a milestone event in direct support to the warfighter. On the afternoon of 22 Oct 96, an AC-130U Spooky gunship mission was "refragged" on short notice to support an on-call CAS request to provide cover for Army Task Force Eagle, Camp Lisa in Bosnia-Herzegovina. We decided to put a new system to the test. We requested imagery of the potential target area (using only the latitude/longitude coordinates) through normal Request For Information (RFI) channels through the Joint Analysis Center (JAC), and specifically requested the imagery to be broadcast over the newly deployed Joint Broadcast Service (JBS) terminal at San Vito.

The new system worked as advertised. The image was received over JBS and pulled from the JBS server directly to the AFSST TSOC over the local SIPRNET. The team processed the image locally in our Joint Operations Center, put an "up arrow" on it, printed it out, and delivered it to the AC-130U Fire Control Officer at the Brindisi Air Base flightline in just over 3 hours from time of request to time of receipt onboard the aircraft. We believe this is a first in imagery support to an **operational** aircrew. This historical achievement supported a refragged real-world mission using the JBS system tied in directly to the AFSST TSOC. The bottom line is that when we needed it, our Fire Control Officer on board the gunship had a picture in hand that looked like the picture on his sensor displays once he arrived over the target area. He knew exactly what to look for when he got over the target.

The AFSOC AFSST left San Vito 24 Oct 96. Their deployment was a great success. Our aircrew mission planners miss having them in the JOC as a continued presence and also miss the custom products they provided. The team built a good sample of approach images of many of the AOR airfields and HLZs to leave behind with the squadron mission planners. Our intent is to recall them in the event of a contingency requiring their immediate support. At the

very least, we requested their routine return to JSOTF2 to maintain AFSST team proficiency and mission familiarization in support of deployed special operations forces, if we are still there...



AC-130U Spooky Gunship of the 4th Special Operations Squadron

Author's **Epilogue**, 1 Mar 99: **We're still there!** It was supposed to be a temporary short-term deployment that has now lasted over 5 years. With the crisis in Kosovo, there is no end in sight. The AFSST has deployed to JSOTF2 and other JSOTFs in Asia and South West Asia at a rate of every 4 to 5 months over the last 3 years. Instead of a TSOC we now use a system called Satellite and Missile Analysis Tool (SMAT), to provide us an orbitology and sensor coverage visualization tool. We also have the Worldwide Origin Threat System (WOTS) that was developed by USSPACECOM that provides us our own theater missile warning system, and Weather Front that provides direct downlink of weather imagery to forward deployed forces. In addition, we take the Precision Lightweight GPS Receiver (PLGR) and the OMEGA software to the field to provide GPS almanac and accuracy predictions to mission planners. Thanks to the addition of two more 13S4 Space Operations Officers and the development of our AFSOC Space Training Facility, we are transitioning from the reliance on AFSPACECOM, 76 SOPS AFSST deployments. Our goal is to inherently train the AFSST capability to our own special operations forces operators, intelligence and communications folks to build our own contingency space support capability.

Maj Al "Cowboy" Kirkham.

SPACE TASKING ORDER (STO) AND AIR TASKING ORDER (ATO) INTEGRATION

Capt Bob Carneal, HQ SWC/DOOS, DSN 560-9893

Imagine you are the Joint Force Air Component Commander (JFACC) in a given theater. You are responsible for the AeroSpace campaign. You utilize the ATO to plan, task and direct theater air operations. How do you get visibility into space assets and how would you direct the activities of space units/assets transferred to your operational control?

Wait a minute. Why do you even care about visibility into space operations in your campaign? Think about it. You are responsible not only for the air piece, but space, as well, in your AeroSpace campaign. So what? Space assets provide persistence from the "high ground." They provide wireless communications in an austere environment, not only to your aircraft beyond line-of-sight, but also reachback to rear operating locations. Under the Expeditionary AeroSpace Force concept, your communications architecture is your lifeline to receive operational support from the rear Air Operations Center (AOC), relay orders and get real-time battlespace updates. Space assets provide that persistent battlespace awareness. They watch for missile launches and let you know—both friendly and adversary—who's forces are where and if they're moving. Without space assets on your side, you're "deaf, dumb and blind." So now the pucker factor is up, who ya gonna call?

United States Space Command has approved direct liaison authority between COMAFSPACE's Space Operations Center (SOC) at Vandenberg AFB CA and theater component commanders. "Stronger" command relations can be approved on a case-by-case basis. Once you identify your space needs, send a Request for Space Support (RSS) (see Figure 1) message to the J36 SPOC or COMAFSPACE SOC.

```
FM SUDAN AIR BASE SAUDI//JFACC//
TO RUWMBIZ/14AF VANDENBERG AFB CA//CC/DO/LG/DOX/DOXZ//
   RUWMBIY/614 SOPS VANDENBERG AFB CA/CC/DO//
INFO RUWTLAA/76 SOPS SCHRIEVER AFB CO//CC/DO/MA//
     USSPACECOM PETERSON AFB CO/J3//
UNCLASSIFIED
SUBJ: (U) REQUEST FOR SPACE SUPPORT
REF: (U) CONTINGENCY MOP SAND
1. (U) JFACC REQUESTS YOU PROVIDE SPACE SUPPORT IN THE FOLLOWING AREAS:
1.1 (U) NAVIGATION ACCURACY.
OPTIMIZE GPS TIMES FOR PGM'S OVER MID-EAST.
 FROM: NOW TO: +72 HOURS
1.2 (U) WARNING.
ESTABLISH AOI OVER MID-EAST. ESTABLISH HOTLINE WITH DIRECT LINK TO SUDAN FOR
MISSILE LAUNCH WARNING.
FROM: NOW TO: TBD
1.3 (U) ENVIRONMENTAL.
NONE.
1.4 (U) SPACE CONTROL
NONE.
1.5 (U) COMMUNICATIONS
PREPARE SPACE ENVIRONMENT STATUS AND INDICATE ANY EFFECTS ON UHF AND SHF
FREQUENCIES.
FROM: NOW TO: TBD
1.6 (U) PRODUCTS REQUESTED.
SPACE INTEL PREP OVER MID-EAST THEATER. PROVIDE SATRAN OF ADVERSARIAL ASSETS.
FROM: NOW TO: +72 HOURS
(U) POC IS LT COL DOE / DO/ 111-1111.
```

Figure 1: ***Sample RSS***

Where you send it will be a function of established command relationships. And if you have no idea what space support you might need, or even what to ask for, just request an Air Force Space Support Team—they deploy into theater and are operational space experts. The RSS outlines specific needs to complement air operations in a given theater. The SOC, in turn, tasks units under control of COMAFSPACE by sending out a STO. These units respond to operational tasking, ensuring the JFACC gets space support for executing theater air operations. But how does the STO merge with the ATO?

The process of merging air and space tasking into one product results in what is called the Integrated Tasking Order (ITO)--this message is under development by the Space Warfare Center and the AeroSpace Command, Control, Intelligence, Surveillance and Reconnaissance Center (AC2ISRC). It provides one cohesive document describing not only what air assets will perform, but how space assets play in the operations. These functions include theater missile warning, navigation accuracy support, space command and control, spacelift, etc. Before integration ever occurs, let's take a look at the STO.

Space taskings fall into three main categories: (see Figure 2)

a. United States Space Command controlled "world-wide" tasks, e.g. day-to-day satellite operations,
b. United States Space Command controlled "theater-specific" tasks, e.g. optimize GPS for CENTCOM, and
c. Theater controlled tasks, e.g., space forces "chopped" to a theater CINC--this concept is still notional and under development for future operations.

Since the JFACC only cares about portions (B) and (C), portion (B) tasks are courtesy copied to the theater AOC. The JFACC provides direct orders for portion (C)--method of control envisioned for future operations. Personnel in the AOC put together the ATO based on JFACC guidance. Portions (B) and (C) are merged into the ATO to create the final product, an ITO.

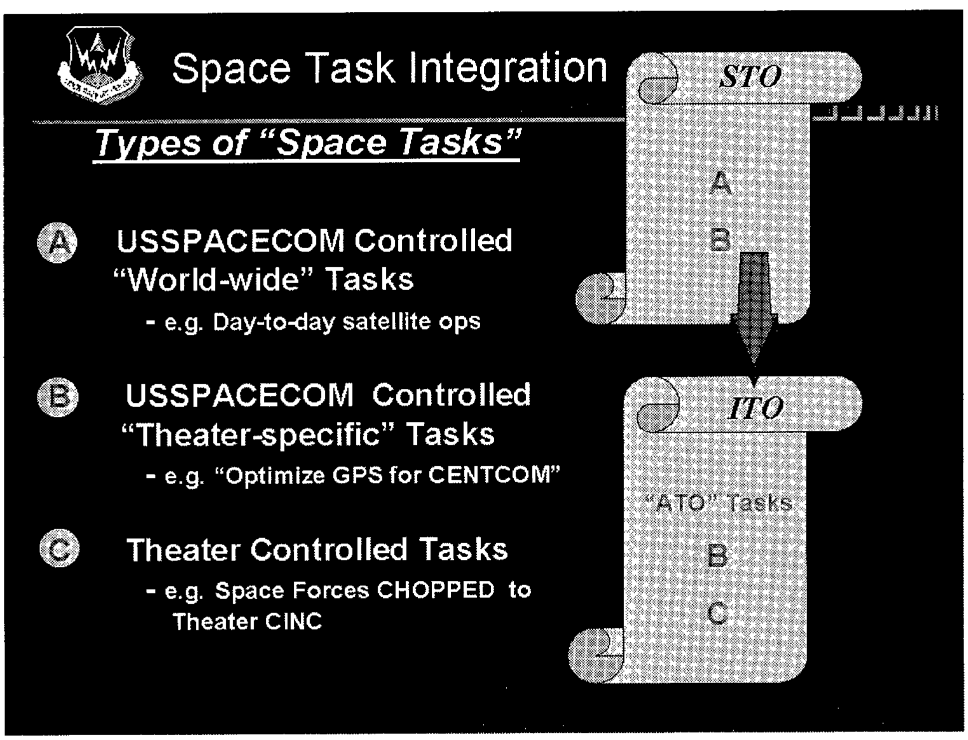


Figure 2: ***STO Merge with ATO to Create Integrated Tasking Order (ITO)***

The STO and ATO are validated in the United States Message Text Format (USMTF). This common baseline means both messages are easily merged. Due to the structure, computer systems can read data fields in both messages. This fact means the JFACC can do a search, for example, on a strike package and GPS. For example, the published ITO could show coordination between the aircraft's time-on-target and optimized GPS, ensuring the strike package can hit its objectives with highest accuracy. (see Figure 3) Further, the JFACC can look and see that space assets are attuned to his theater and will warn him of theater missile launches or impending adversarial movements.

TASKUNIT/10FS/RKJ//
MSNDAT/2003/-/FLAP03/2F15/DCA/-/X2422/-/
101/22003/32003//
MSNLOC/270700Z/270900Z/CENTERCAP/
ALT:250//
REFUEL/DIAI41/5241/SHADOW2/ALT:15/
270645Z/6/-//
MSNDAT/2004/FLAP05/2F15/DCA/-/X2422/-/
101/22005/32005//
MSNLOC/270900Z/271100Z/CENTERCAP/
ALT:250//

MSNDAT/2011/-/BOOMER11/2F15E/OCA/
2A880/-/101/22013/32013//
MSNLOC/270830Z/270930Z/SW16/ALT:0/
3555N12422E//
TGTLOC/270855Z/270856Z/0132-19893/BUN-
KER/3553N12421E/-/-//
TASKUNIT/11SWS//
SPACEMSN/WARNING//
TASKSYS/DSP/TBM WARNING//
TSKPER/270500AUG99Z/280500AUG99//
AREA/KOREA PENN/SEA JAPAN//
GENTEXT/VOICE RPT TO HTACC ROK//

TASKUNIT/43FS/GUZK//
MSNDAT/3547/-/SLAM47/2F16/AI/-/2A881/-/
101/23547/33551//
MSNLOC/270745Z/270800Z/NC17/ALT:0/
BRIDGE//
TASKUNIT/141ARW/RODW//
MSNDAT/5241/-/DIAL11/1KC10/AR/-/BOM/-/
101/23555/33555//
MSNLOC/270630Z/270830Z/SHADOW/ALT:15/-
/3723N12817E//

WHAT IT MEANS...

MISSION: 2xF15E for Offensive Counter Air
TIME / TARGET AREA: 0830Z-0930Z / SW16, 35.55N 124.22E
ALT: 0
TIME / TARGET LOCATION: 0855Z/0856Z / BUNKER: 35.53N 124.21

WHO: 11th Space Warning Squadron
MISSION: Theater Warning
TASKED SYSTEM: DSP
WHEN: 27 AUG 99 - 28 AUG 99
WHERE: KOREA PENN, SEA OF JAPAN
WHAT: TBM DIRECT SUPPORT TO AOR,VOICE RPT TO HTACC ROK

Figure 3: *Sample Integrated Tasking Order (ITO)*

How exactly is the battle rhythm performed for merging STO and ATO? COMAFSPACE's SOC performs analogous functions for space assets as found in an AOC for air assets. The SOC is functionally organized into Strategy, Combat Plans and Combat Operations. Since the JFACC has these same functions in an AOC, the SOC parallels the well-defined battle rhythm coordination process (see Figure 4). In the SOC, Strategy uses the Air Force Space Operations Plan to setup its approach for operational support to a given theater. Combat Plans takes this product and applies it to creating a STO, then sends this message to COMAFSPACE's units for implementation, along with a courtesy copy message to the JFACC's AOC. Strategy coordinates with the JFACC's Strategy to assess execution. As required, the SOC's Combat Plans and Combat Operations coordinate with their counterparts in the JFACC's AOC.

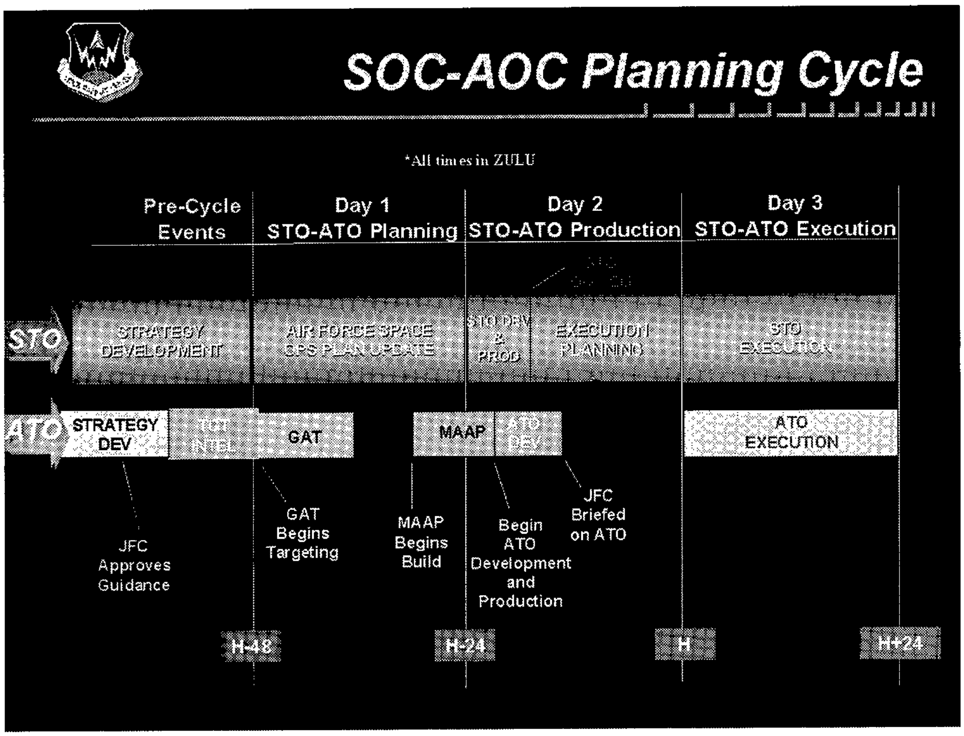


***Figure 4:** Battle Rhythm Coordination Cycle*

In summary, the ITO serves several critical functions from a space integration perspective:

- Space assets are coordinated into an operational theater campaign
- Space assets "chopped" to the JFACC can be formally tasked—future operational concept
- Both air and space assets work together as an AeroSpace force package

POC: Maj John Nunez (DSN 560-9657), HQ SWC/DOO

21ST SW WORKING TO STAND UP WING OPERATIONS CENTER (WOC)

Lt Col Grace D.C. McCann, 21 SW/XP (DSN 834-6487), Capt Rick Forristall, 21 SW/XPO, (DSN 834-4629) and TSgt Sue Thompson, 21 SW/XPO, (DSN 834-5023).

BACKGROUND:

The 21st Space Wing (21 SW) located at Peterson AFB, Colorado Springs, CO is in the process of standing up the 21 SW WOC to manage missile warning sensor management of 21 SW operational units. Through the WOC, the 21 SW Commander and staff will receive the orders, directives, and guidance used to plan and manage resources and direct operations. 21 SW WOC personnel will perform missile warning sensor management, direct ground system configuration, employ space tactics, monitor and manage the readiness and alert capability of assigned forces, and control unit operations during peacetime and wartime. The command post forms the core of the WOC. The title "Command Post" will no longer be used under the WOC concept. The 21 SW will provide support for the continuity of USCINCSPACE strategic missile warning operations, space control functions, guidance, and direction for using 21 SW resources to support Chairman of the Joint Chiefs of Staff (CJCS) and USCINCSPACE requirements. The WOC will consist of a WOC Director, WOC Chief, support staff, and 5 crews of 4 people. The crew makeup will be 1-13SXX (space & missile operations officer - crew commander), 1-1C6XX (enlisted space operator), and 2-1C3XXs (enlisted command post controllers). By the completion of phase II this crew will be responsible for both Tactical Control (TACON) of 21 SW operational units and function in the same role as the command post for the wing commander. Standing up the WOC is a 3-phased process.

Phase I consists primarily of the "kick off" with a name change to the WOC. The AFSPC Space Operations Center (SOC) at Vandenberg AFB, CA will maintain TACON and Operational Control (OPCON) of all missile-warning sensors in the 21st Space Wing. In the latter part of this phase and the beginning of phase II, 21 SW WOC will be responsible for missile warning sensor management in the event AFSPC SOC can't perform its function for any reason.

Phase II consists of 21 SW WOC beginning full-time operations and assuming, from the AFSPC SOC, TACON of 21 SW missile warning units. In this capacity, the 21 SW WOC will be responsible 24 hours per day/7 days per week for ensuring the 21 SW missile warning operational units are optimally configured through missile warning sensor management. AFSPC SOC will build the Space Tasking Order (STO) and disseminate it to all AFSPC units for implementation/action. The 21 SW WOC reacts to all STOs received from AFSPC SOC.

Phase III consists of the 21 SW WOC functioning as the alternate AFSPC SOC. The 21 SW WOC (as the alternate AFSPC SOC) will maintain the hot backup capability to perform minimum essential AFSPC SOC command and control functions. It will be activated in response to an emergency, crisis, or contingency situation where the AFSPC SOC cannot perform its mission. Actions unique to other wings (50 SW, 30 SW 45 SW) will filter down to the applicable unit WOC. When the alternate SOC is activated and becomes the primary for over 24 hours, the 614th Space Operations Squadron, 614th Reserve Associate Unit, and 14 AF personnel will augment the 21 SW WOC as required. The alternate SOC will:

- Receive and monitor force status and readiness information from AFSPC assigned forces.
- Maintain and report the operational capabilities, emergency action procedures, status, and outage impact assessment to USSPACECOM SPOC on all AFSPC assigned force.
- Provide administrative information, to include location of key personnel and deployed Air Force Space Support Teams (who, what, when, where) to the USSPACECOM SPOC.
- Produce and disseminate the STO and changes when AFSPC SOC can't perform this function.

STATUS OF THE PROJECT:

Phase I was completed on 1 Oct 98. The 21 SW WOC was transferred to the 21st Operations Group on 30 Nov 98. Det 1, 533d Training Squadron & AFSPC SOC members provided Initial Qualification Training and Upgrade Qualification Training (IQT/UQT) to the initial cadre of 21 SW WOC crewmembers from 23 Nov - 4 Dec/7-10 Dec 98. Activation of the Missile Warning Sensor Management function occurred on 16 Feb 99 at which point a 60-day trial period commenced.

FUTURE OF THE PROJECT:

Phase II is projected to commence on 1 July 1999 with Phase III's start date still to be determined.

USAF WEAPONS SCHOOL SPACE DIVISION CORNER

Lt Col Gregg "Mr. Bill" Billman, WSS/CC, DSN 682-2065

Lots of exciting stuff is happening out here at Nellis—as usual! Between graduating our sixth class, deploying instructors abroad, celebrating the Weapons School's 50th Anniversary, executing our first-ever "Re-Blue" program, participating in EFX 99, preparing for JEFX 2000, increasing our class sizes to twelve and preparing to put sister service and AGR space officers through our program, time really flies by.

Our sixth class of space weapons officers graduated 19 June, amid all of the hooplah associated with the USAF Weapons School's 50th Anniversary celebration. Many graduates returned that week for those two big events, as well as the following week's "Re-Blue" program. Our "Re-Blue" classes went a long way towards bringing all of our alumni up-to-date on advances in the division's curriculum since they left.

As I prepare to leave this organization after two years of working with some of the best and brightest folks I've ever had the honor of being associated with, I am proud to look back on their accomplishments. But it's even better to look forward. Our graduates and the rest of you hard-charging space warriors out there, make me optimistic about military space's future.

My replacement, Lt Col Greg "Chappy" Chapman (99A), is the luckiest guy in the Air Force. He gets to work with all of these great folks out here—and do all this fun stuff!

I don't want to leave—but they're making me go! Those fingernail marks on the road leading out of Nellis are mine. See you down the road and in the trenches.

Check Six, Twelve, LEO and GEO!!!

USAF WEAPONS SCHOOL SPACE DIVISION INSTRUCTOR CADRE

NAME	TITLE	AREAS OF RESPONSIBILITY	DSN 682-XXXX	EMAIL
FRONT OFFICE				
Lt Col Gregory Billman	Commander	Space Policy & Space Doctrine Joint Operations Planning Weapons Officer Training	x-2065	wss@nellis.af.mil
Maj Frank Gallagher	Ops Officer	COMSATS & SIGINT Theater Missile Defense Weapons Officer Training	x-5184	frank.gallagher@nellis.af.mil
Maj Christopher Kinnan	Asst Ops Officer	Orbital Mechanics NAVWAR & Theater Missile Defense AOC Operations	x-3336	christopher.kinnan@nellis.af.mil
Maj Joanna Sobieski	Asst Ops Officer	GPS & Remote Sensing (MSI/IMINT) National Systems	x-4718	joanna.sobieski@nellis.af.mil
TSGT Emma Duren	Info Security	Administration & Security	x-4380	emma.duren@nellis.af.mil
MISSIONS FLIGHT				
Maj Don Ridolfi	Flt Commander	Theater Missile Defense Space Operations Planning	x-6571	donald.ridolfi@nellis.af.mil
Capt Jim Lindsay	Instructor	SIGINT & IMINT & MASINT	x-7106	jim.lindsay@nellis.af.mil
Capt Todd Brost	Instructor	COMSATS Space Control	x-6719	todd.brost@nellis.af.mil
Capt Billy Starkey	Instructor	Space Control	x-6719	billy.starkey@nellis.af.mil
ACADEMIC FLIGHT				
Capt Bruce Rayno	Flt Commander	Remote Sensing (Weather & IMINT) Space Environment	x-5360	bruce.rayno@nellis.af.mil
Capt Al Rebholz	Instructor	Space Control	x-6962	alan.rebholz@nellis.af.mil
Capt George Pulliam	Instructor	Theater Missile Defense	x-5360	george.pulliam@nellis.af.mil
TRAINING FLIGHT				
Maj M. V. Smith	Flt Commander	GPS/NAVWAR Launch Systems Space Control	x-5538	michael.smith@nellis.af.mil
ATTACHED INSTRUCTOR				
Major Robert Wasserman	Asst Ops Officer	USAFWS/WSP COMSATS Theater Missile Defense	x-4797	robert.wasserman@nellis.af.mil

E-MAIL FOR UNCLASSIFIED ARTICLES THRU WEAPONS SCHOOL: wwwmil.nellis.af.mil/usafws/spacesp.htm
SIPRNET address: 204.20.177.66

☆ U.S. GOVERNMENT PRINTING OFFICE: 1999-775-915